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ABSTRACT

This report describes the U.S. soybean industry from producers to consumers and provides a single source of economic and statistical information on soybeans. Highlights are as follows: U.S. soybean production has increased sevenfold since 1950, making soybeans the second highest valued crop after corn. Soybean production has risen in response to increasing world demand for soybeans and their derivative products, oil and meal. The U.S. share of the world export market has ranged from 65 to 80 percent during the 1980s. Soybean oil accounts for 75 percent of the fats and oils used in edible oil products. Soybean meal is the major high-protein feed for livestock in the United States. U.S. farmers have increased their soybean plantings from 15.6 million acres in 1950 to 60.4 million acres in 1986. Production increased from 299.2 million to nearly 2 billion bushels, with the average yield per acre increasing from 21.6 to 33.3 bushels. About 55 percent of the U.S soybean crop is crushed domestically, with most of the rest exported as beans. Soybean prices increased moderately through the 1960s and then jumped sharply in the 1970s, reflecting crop failures abroad and increasing world demand for protein feeds. Since the 1970s, soybean prices have fluctuated widely. Government price supports have been available for soybeans every year since 1941 except for 1975, with the season average price exceeding the price support level for most years. The United States remains the world's leading producer and exporter of soybeans; however, its share of world production has dropped from 74 percent in 1967-69 to 56 percent during 1984-86. (MN)

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The U.S. Soybean Industry

James Schaub
W.C. McArthur
Duane Hacklander
Joseph Glauber
Mack Leath
Harry Doty

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Abstract

U.S. soybean production has increased sevenfold since 1950, making soybeans the second highest valued crop after corn. Soybean production has risen in response to increasing world demand for soybeans and the derivative products, oil and meal. The U.S. share of the world export market has ranged from 65–80 percent during the 1980's. Soybean oil accounts for 75 percent of the fats and oils used in edible oil products. Soybean meal is the major high-protein feed fed to livestock in the United States. This report describes the U.S. soybean industry from producers to consumers and provides a single source of economic and statistical information on soybeans.

Keywords: Soybeans, soybean meal, soybean oil, oilseeds, Government programs, prices, marketing, exports.

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Highlights

U.S. soybean production has increased sevenfold since 1950, making soybeans the second highest valued crop after corn. Soybean production has risen in response to increasing world demand for soybeans and their derivative products, oil and meal. The U.S. share of the world soybean export market has ranged from 65–80 percent during the 1980's. Soybean oil accounts for 75 percent of the fats and oils used in edible oil products. Soybean meal is the major high-protein feed fed to livestock in the United States.

This report describes the U.S. soybean industry from producers to consumers and provides a single source of economic and statistical information on soybeans.

U.S. farmers increased soybean plantings from 15.6 million acres in 1950 to 60.4 million acres in 1986. Production increased from 299.2 million to nearly 2 billion bushels. Average yield per acre increased from 21.6 to 33.3 bushels.

About 55 percent of the U.S. soybean crop is crushed domestically. Most of the rest is exported as beans. Soybean meal is the principal livestock feed used in the United States; about 45 percent is fed to poultry, and about 30 percent is fed to hogs. Soybean oil is the dominant vegetable oil used in edible oil products, such as salad and cooking oils, baking and frying fats, and margarine.

Soybean prices increased moderately through the 1960's, then jumped sharply in the 1970's, reflecting crop failures abroad and increasing world demand for protein feeds. Soybean prices have fluctuated widely since the 1970's, as have prices for soybean oil and meal.

Government price supports have been available for soybeans every year since 1941 except for 1975. The season average price has exceeded the price support level for most years. The loan rate was $5.02 per bushel in 1985 and $4.77 per bushel in 1986.

The United States, the leading producer and exporter of soybeans, nevertheless saw its share of world production drop from 74 percent during 1967–69 to 56 percent during 1984–86. Brazil and Argentina became major competitors during that period, increasing their share of world production from 2.8 percent to 24.4 percent.

Japan and the European Community (EC) are the principal importers of U.S. soybeans. The EC and other European countries are the major importers of U.S. soybean meal. Pakistan, India, and Mexico are the major importers of U.S. soybean oil.

The U.S. Soybean Industry

James Schaub, W. C. McArthur, Duane Hacklander, Joseph Glauber, Mack Leath, Harry Doty*

Introduction

Soybeans are the second highest valued U.S. crop, with an aggregate production value over $9.2 billion in 1986, surpassed only by corn (*61*).[1] Soybeans have been one of agriculture's fastest growing industries in recent decades. Domestic production increased over sevenfold in the last three decades, while world production rose about fivefold. This rapid growth in the volume produced and processed resulted largely from increasing world demand for soybeans and the primary products, soybean oil and soybean meal.

This report provides information on the structure and performance of the soybean industry and emphasizes production trends, practices, and costs; uses; prices; Government programs; marketing patterns and transportation; processing; and world trade.

Soybeans were cultivated in ancient China, Manchuria, and neighboring countries (*38*). The crop was introduced into the United States from the Orient during the early 1800's, but it had little economic importance here for several decades, with production being used primarily for hay.

Soybeans were first processed for oil and meal in the United States about 1910 by an oil mill on the west coast (*9*). This mill processed beans that were imported from Manchuria. U.S. production was first used for processing in 1914 when a few cottonseed oil mills in North Carolina began crushing soybeans. The use of cottonseed oil mills for this purpose spread to other mills in the South, but these first efforts were unsuccessful due to a lack of processing experience and difficulties in obtaining a local supply of soybeans. Commercially successful processing of U.S. soybeans began in 1922. After this initial success, several other companies entered the soybean processing business in the 1920's. The industry has continued to expand.

Production

Soybeans are grown in all States in the area bounded by North Dakota, Texas, Florida, and New Jersey (fig. 1). This section describes production patterns and trends since 1950, characteristics of farms growing soybeans, soybean supply, factors leading to production adjustments, and costs and returns from soybean production. The major soybean-producing States are grouped into seven production regions for comparing yields, production practices, trends, and other factors among relatively homogeneous regions (fig. 2). The minor soybean-producing States (Delaware, Maryland, New Jersey, and Pennsylvania) are reported in the tables as "Other."

Production Patterns and Trends

Soybeans are generally planted in May and June. The soybean plant flowers and pod-filling occurs in July and August. Harvesting begins in September and is largely completed by mid-November. Production is concentrated in the Corn Belt, the region with the highest average yields.

Planted Acres. Increasing world demand for soybeans and their products during the last three decades encouraged the expansion of soybean acreage. U.S. soybean acreage has increased steadily since 1950 when 15.6 million acres were planted (table 1). Plantings peaked at 71.4 million acres in 1979 and dropped to 60.4 million acres by 1986. The largest year-to-year increase occurred in 1973 when 9.6 million acres were added. Soybean plantings fell a record 7.1 million acres in 1983 when the payment-in-kind (PIK) program was in effect. Although

* Schaub, Glauber, and Leath are agricultural economists in the Commodity Economics Division (CED), Economic Research Service (ERS), U.S. Department of Agriculture. McArthur, Hacklander, and Doty were associated with CED at the time this research was conducted. Hacklander is now in the Agriculture and Rural Economy Division, ERS. McArthur and Doty have retired.

[1] Italicized numbers in parentheses identify sources listed in the References section.

Figure 1

Soybeans harvested for beans, 1982

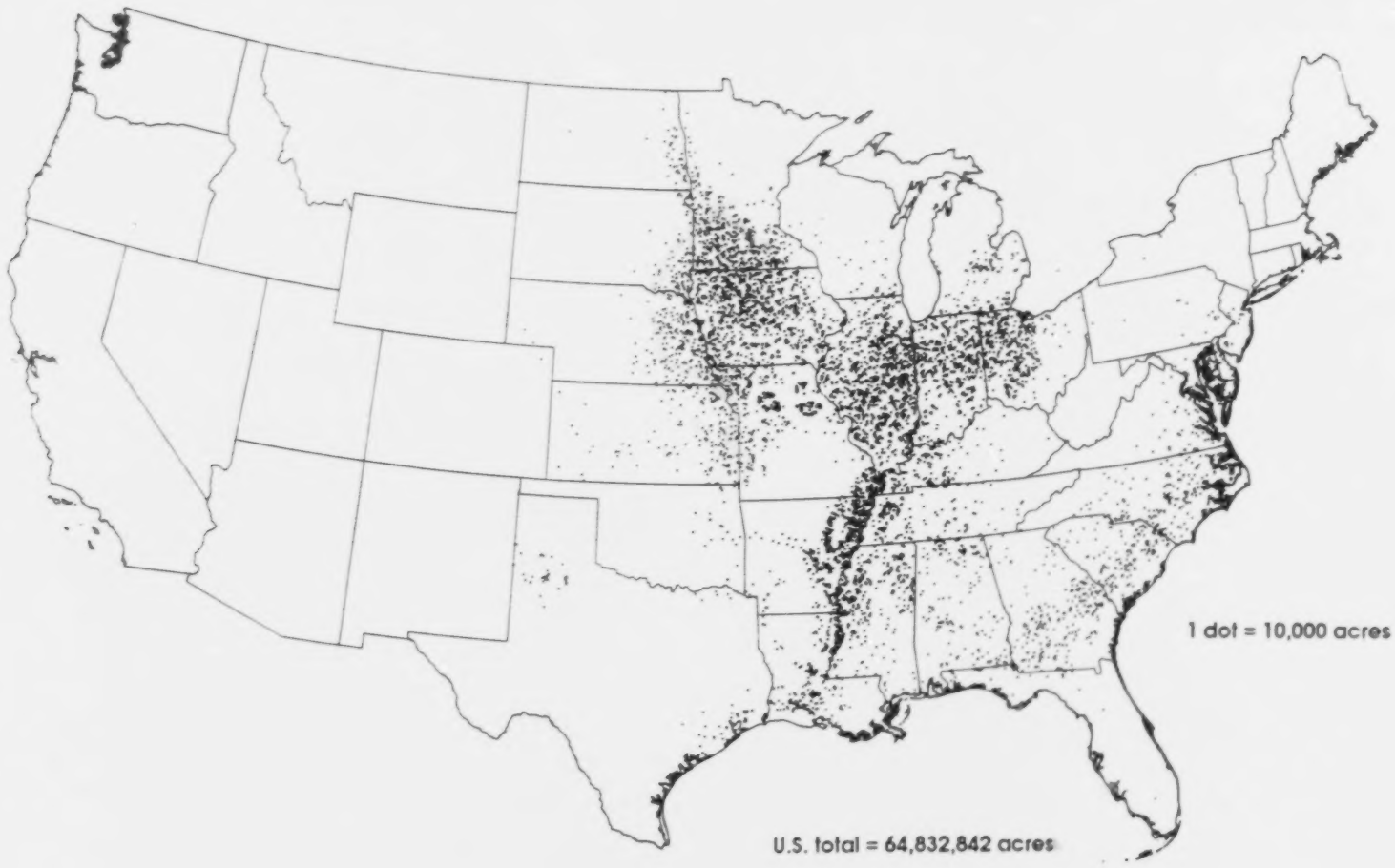


Figure 2
Major soybean production regions

soybeans were not covered in the PIK program, soybean acreage declined because soybeans were not allowed to be planted on conservation use acres, such as those set aside in the wheat PIK program. Even so, soybean plantings exceeded corn plantings. Overall, farmers planted four times as many acres to soybeans in 1986 as in 1950. Trends in soybean planted acres, yields, and production are measured in appendix A.

Production. Production gains were even more dramatic than acreage gains, increasing 600 percent between 1950 and 1985. From a base of 300 million bushels in 1950, soybean production trended upward, never displaying back-to-back yearly decreases in production (table 1). The largest crop was in 1979, when the 2-billion-bushel mark was first passed, with 2,261 million bushels harvested. Production exceeded 2 billion bushels again in 1982 and 1985. The 1985 crop, 2,099 million bushels, was produced on significantly fewer acres than the other 2-billion-bushel crops.

Yields. Soybean yields have trended upward during the last 37 years, ranging from a low of 18.2 bushels per acre in 1953 to a record high 34.1 bushels per acre in 1985 (table 1). National average yields have been in the 30-bushel range five times since first breaking the 30 bushels per acre mark in 1977. The largest swings in yields were +6.0 in 1985 and −5.6 in 1980.

A high-yielding hybrid soybean variety, such as that achieved with corn, has not been developed. Increases in yields have come from better cultivating and harvesting practices and improved plant varieties. Plant scientists are pursuing the genetic alteration of soybeans for improved yields using biotechnology methods.

Crop rotation, typically corn with soybeans, is a common practice that improves soybean yields. Double-cropping soybeans with wheat has become more common in the South. However, yields of double-cropped soybeans tend to be lower than single-cropped beans, restraining the national annual yield gain (*24*).

Weather significantly affects soybean yields. Insufficient moisture and unusually high temperatures in August, when flowering ends and pod-filling begins, substantially reduces yields. Just 3 percent of the farms producing soybeans irrigate, and only 3.5 percent of the harvested soybean acreage is irrigated.

Regional Perspective. Soybean acreage trended upward nationally and in every region from 1950 to 1985. The Southeast had the greatest percentage

increase in acres between 1950–54 and 1980–85 (table 2). The Corn Belt's percentage increase was the smallest, but this region added the most acres to U.S. soybean production.

Increased yields in all regions accompanied the expansion of soybean acreage (table 2). The Northern Plains led all regions, gaining 13.8 bushels per acre between 1950–54 and 1980–85, to become the third highest yielding region behind the Corn Belt and the Lake States. The Lake States increased yields 13.3 bushels per acre and now average over 30 bushels per acre. The three Southern regions had the smallest yield increases. Their 1980–85 average yields were less than 25 bushels per acre. Among the factors limiting yield gains in the South have been the cyst nematode, the practice of double-cropping soybeans with wheat, three droughts since 1980, and generally poorer quality soils for soybean production.

Table 1—U.S. soybean planted acres, yield, and production

Year	Planted acres	Yield	Production
	Millions	*Bushels per harvested acre*	*Million bushels*
1950	15.6	21.6	299.2
1951	15.7	20.8	283.8
1952	16.4	20.7	298.8
1953	16.7	18.2	269.2
1954	18.9	20.0	341.1
1955	20.0	20.1	373.7
1956	22.0	21.8	449.3
1957	22.2	23.2	483.3
1958	25.3	24.2	580.3
1959	23.6	23.5	532.9
1960	24.6	23.5	555.1
1961	28.0	25.1	678.6
1962	28.6	24.2	669.2
1963	29.6	24.4	699.2
1964	31.7	22.8	700.9
1965	35.2	24.5	845.6
1966	37.3	25.4	928.5
1967	40.8	24.5	976.4
1968	42.3	26.7	1,107.0
1969	42.5	27.4	1,133.1
1970	43.1	26.7	1,127.1
1971	43.5	27.5	1,176.1
1972	46.9	27.8	1,270.6
1973	56.5	27.8	1,547.5
1974	52.5	23.7	1,216.3
1975	54.6	28.9	1,548.3
1976	50.3	26.1	1,288.6
1977	59.0	30.6	1,767.3
1978	64.7	29.4	1,868.8
1979	71.4	32.1	2,260.7
1980	69.9	26.5	1,797.5
1981	67.8	30.1	1,989.1
1982	70.9	31.5	2,190.3
1983	63.8	26.2	1,635.8
1984	67.8	28.1	1,860.9
1985	63.1	34.1	2,098.5
1986	60.4	33.3	1,940.1

Source: (*50, 60*).

Illinois, Indiana, Iowa, Minnesota, Ohio, and Wisconsin had yields of 30 or more bushels per acre at least nine times between 1975 and 1985. Illinois, Indiana, and Ohio had yields of at least 40 bushels per acre in 1985. Only Kansas and Oklahoma had yields below 20 bushels per acre in 5 of the last 10 years.

The Corn Belt, with the highest average yield and greatest acreage, remains the most important soybean producing region, accounting for more than half the U.S. production (table 2). The Southern Plains region produces the smallest soybean crop. Even so, the average annual value of this area's soybean production was over $100 million during 1980–85.

Mix of Major Crops. The crop mix by region illustrates the regional effects of the soybean programs and programs for competing crops, such as corn. Crop mix information also provides insights into where soybean production adjustments, such as acreage expansion, might occur.

Soybeans dominate the planted acreage in the Delta, accounting for nearly half the acreage planted to principal crops (table 3). Other regions where soybeans account for a substantial part of the acreage are the Corn Belt, Appalachia, and the Southeast. Soybeans are planted on less than 10 percent of the cropland in the Southern and Northern Plains where wheat dominates. Although corn is an important alternative crop in most regions, it is a minor crop in the Delta States and Southern Plains compared with wheat, cotton, rice, and sorghum.

Shifts in Location of Production. Soybean acreage and yields have increased in all regions since 1950 but at uneven rates. The Corn Belt's extremely large share of U.S. soybean production (nearly 75 percent in 1950) has fallen since 1950–54 (table 4). Major share gainers have been the Delta, the Southeast, the Northern Plains, and Appalachia. The Corn Belt's share has declined, not because its yield increases failed to keep pace with those of other regions, but because Corn Belt acreage increased less, by 205 percent compared with an average rise of 675 percent for all other regions.

Several factors account for relative shifts in the location of production, including soybean profitability compared with alternative crops, variability of soybean returns, regional differences in climate, and production practices, including double cropping and crop rotation schemes. Additional land for soybean produc-

tion came from new acres put into production and from displacement of other crops. In the Corn Belt during the 1950's, soybeans accounted for about 15 percent of harvested acreage; corn, 39 percent; and oats, 15 percent. Since then, soybean's share of harvested acreage increased to 36 percent, corn's share increased to 43 percent, and oat's share decreased to 2 percent. In the Delta, the crop mix changed even more since the 1950's: corn decreased from 21 percent to 1 percent, wheat increased from 1 percent to 12 percent, cotton decreased from 30 percent to 11 percent, and soybean's share of acres increased from 5 percent to 48 percent. The Southeast crop mix also changed dramatically. There, soybean's share of acreage increased from 3 percent to 38 percent, cotton decreased from 19 percent to 5 percent, and corn fell from 38 percent to 16 percent.

Characteristics of Farms Harvesting Soybeans

Soybeans are produced under a variety of farm enterprise structures, ranging from small-scale individual proprietorships to large-acreage corporate farms. This section describes selected structural characteristics of

Table 2—Soybean planted and harvested acres, yields, and production, by region

Region	1950–54	1955–59	1960–64	1965–69	1970–74	1975–79	1980–85
				1,000 acres			
Planted acres:							
Lake States	1,582	2,936	2,819	3,981	4,237	4,958	6,365
Corn Belt	10,456	13,100	16,032	20,027	25,156	28,440	31,022
Northern Plains	759	959	1,400	2,230	2,420	3,065	5,304
Southern Plains	95	103	228	404	446	977	853
Appalachia	1,317	1,395	1,929	2,957	3,960	5,684	6,299
Southeast	487	717	1,000	1,981	2,947	4,841	5,812
Delta	2,131	2,495	4,433	7,278	8,732	11,151	10,538
Other	267	439	490	429	584	855	972
United States	17,094	22,144	28,331	39,287	48,481	59,971	67,168
Harvested acres:							
Lake States	1,504	2,860	2,783	3,919	4,177	4,899	6,255
Corn Belt	10,066	12,862	15,870	20,076	24,881	28,224	30,663
Northern Plains	671	905	1,366	2,188	2,362	3,002	5,151
Southern Plains	54	82	206	380	417	917	773
Appalachia	759	1,113	1,640	2,687	3,733	5,444	6,076
Southeast	239	545	911	1,867	2,847	4,681	5,552
Delta	1,183	2,651	4,301	7,106	8,533	10,946	10,183
Other	201	383	454	413	570	839	950
United States	14,677	21,401	27,531	38,636	47,520	58,952	65,603
				Bushels per acre			
Yields:							
Lake States	19.1	19.6	21.3	21.8	25.4	30.3	32.4
Corn Belt	22.0	24.6	26.5	28.8	29.8	34.1	34.3
Northern Plains	14.0	15.3	19.7	22.8	23.2	26.5	27.8
Southern Plains	11.3	20.0	20.7	23.5	22.8	24.4	22.2
Appalachia	16.6	20.8	22.2	23.6	24.1	25.4	24.2
Southeast	13.2	17.3	19.8	21.6	21.5	22.8	20.5
Delta	15.1	20.9	20.0	22.6	22.1	24.3	22.3
Other	17.5	22.1	20.3	24.0	26.8	28.0	27.5
United States	20.3	22.6	24.0	25.8	26.7	29.6	29.4
				1,000 bushels			
Production:							
Lake States	28,765	55,923	59,244	85,385	105,962	148,602	202,705
Corn Belt	221,841	316,435	420,294	578,866	742,433	961,068	1,051,265
Northern Plains	9,401	13,865	26,972	49,968	54,712	79,556	143,341
Southern Plains	608	1,648	4,273	8,944	9,508	22,334	17,165
Appalachia	12,598	23,116	36,453	63,460	89,943	137,984	146,888
Southeast	3,163	9,431	18,029	40,290	61,065	106,874	113,963
Delta	17,887	55,487	86,040	160,379	188,404	266,327	227,119
Other	3,508	8,462	9,224	9,897	15,282	23,509	26,163
United States	297,770	484,368	660,529	997,189	1,267,309	1,746,253	1,928,609

Source: (*50, 60*).

soybean-producing farms with emphasis on regional differences in acreage, sales, organization, operator tenure, and irrigation.

Number and Sizes of Farms. The 1982 Census of Agriculture reported 511,229 farms harvesting soybeans (table 5). The number of soybean-harvesting farms in each region, except for the Delta States and Appalachia, is generally proportional to that region's share of total soybean production. The Delta's share of production is much larger than its share of farms because its average soybean acreage is so large. Appalachia has a larger share of farms than production because average soybean acreage is small and yields are below average.

Forty percent of the Nation's soybean-harvesting farms harvest fewer than 50 acres of soybeans, 25

Table 3—Proportion of total acreage of planted to selected crops, by region

Region/year	Soybeans	Sorghum	Wheat	Corn	Cotton	Rice	Other crops	All principal crops
	Percent							*1,000 acres*
Lake States:								
1984	18.0	0	9.9	37.2	0	0	34.9	38,864
1985	16.9	0	9.7	37.9	0	0	35.5	38,789
Corn Belt:								
1984	35.9	2.0	7.6	42.3	.2	.1	11.9	87,538
1985	35.4	2.2	4.8	44.2	.2	.1	13.1	87,549
Northern Plains:								
1984	8.2	9.5	37.3	16.4	0	0	28.6	78,671
1985	7.2	9.5	36.3	15.9	0	0	31.1	78,538
Southern Plains:								
1984	2.2	15.7	48.5	5.6	18.6	1.3	8.1	31,145
1985	1.7	15.4	50.0	5.1	16.9	1.0	9.9	31,787
Appalachia:								
1984	28.9	2.5	11.3	24.8	2.1	0	30.4	20,825
1985	26.0	3.6	9.5	26.4	.6	0	33.9	20,275
Southeast:								
1984	38.4	3.2	13.5	16.3	4.3	0	24.3	13,954
1985	33.5	4.0	15.6	17.0	5.6	0	24.3	13,226
Delta:								
1984	49.0	6.6	13.3	1.3	10.8	9.4	9.6	20,105
1985	47.3	11.0	7.0	2.5	11.7	9.3	11.2	18,389
Other:								
1984	1.9	1.6	32.1	12.3	3.7	.9	47.5	54,008
1985	1.8	1.4	33.3	14.5	4.0	.8	44.3	53,711
United States:								
1984	19.6	5.0	23.0	23.4	3.2	.8	25.0	345,110
1985	18.5	5.3	22.1	24.4	3.1	.7	25.9	342,264

Source: (*60*).

Table 4—Regional shares of soybean production

Region	1950–54	1955–59	1960–64	1965–69	1970–74	1975–79	1980–85
	Percent						
Lake States	9.6	11.5	9.0	8.6	8.4	8.5	10.5
Corn Belt	74.5	65.3	63.6	58.0	58.6	55.0	54.5
Northern Plains	3.2	2.9	4.1	5.0	4.3	4.6	7.4
Southern Plains	.2	.3	.7	.9	.7	1.3	.9
Appalachia	4.2	4.8	5.5	6.4	7.1	7.9	7.6
Southeast	1.1	2.0	2.7	4.0	4.8	6.1	5.9
Delta	6.0	11.5	13.0	16.1	14.9	15.3	11.8
Other	1.2	1.7	1.4	1.0	1.2	1.3	1.4

Source: (*50, 60*).

percent harvest 100–249 acres, and 4 percent harvest over 500 acres. This size distribution varies significantly across regions. Soybean-harvesting farms in Appalachia tend to be small; 58 percent harvested fewer than 50 acres of soybeans. The Delta States' farms harvest on average the most soybean acres, 338 acres. Nearly 22 percent of the farms growing soybeans in the Delta harvest more than 500 acres. Only 1 percent of the Nation's soybean producers are in the Southern Plains, but they have a relatively large proportion of large farms (250 or more acres of soybeans).

Value of Sales. Classifying soybean-harvesting farms by value of sales results in a distribution across sales classes and regions similar to the distribution by acres (table 6). The Southern Plains and Delta had the largest proportions of farms with sales of $100,000 or more. However, most farms with large sales are in the Corn Belt. Appalachia and the Southeast had the largest proportions of farms in the two smallest sales categories. Nationally, 33 percent of soybean-harvesting farms had sales below $20,000 compared with 47 percent in Appalachia and the Southeast.

Specialized Soybean Farms. The Census of Agriculture classifies soybean farms as those where soybeans account for 50 percent or more of sales. Figure 3 shows the 1982 distribution of the Nation's 129,607 specialized soybean farms across regions, and table 7 shows three measures of these farms' sizes: average acres of harvested cropland, average capital assets, and average value of sales. The Corn Belt has the most soybean farms. Soybean farms in the Corn Belt are comparable to those in the Lake States, Appalachia, and the Southeast in all three size measures. The largest soybean farms are in the Southern Plains and the Delta.

Type of Organization. The organization of soybean-harvesting farms does not differ much from the organization of all U.S. farms, nor does it differ much by region (table 8). About 84 percent of the farms are

Table 5—Size distribution of soybean farms, by acres of soybeans harvested, 1982

Region	Share of farms by acres of soybeans harvested							Farms growing soybeans
	1–24	25–49	50–99	100–249	250–499	500–999	1,000 acres or more	
	Percent							*Number*
Lake States	20.8	20.3	24.0	26.6	6.7	1.4	0.2	59,439
Corn Belt	18.4	18.8	23.0	28.3	9.1	2.1	.3	260,171
Northern Plains	17.6	21.6	26.1	26.3	6.7	1.4	.2	48,935
Southern Plains	12.8	14.8	20.3	28.7	14.4	6.7	2.2	5,061
Appalachia	37.0	20.6	17.2	15.5	6.2	2.6	.9	60,656
Southeast	23.6	18.2	18.3	21.9	11.0	5.2	1.7	35,223
Delta	12.5	12.3	13.8	21.1	18.8	14.2	7.4	30,485
Other	37.5	20.0	17.6	16.2	6.2	2.2	.4	11,259
United States	21.2	19.0	21.7	25.3	8.9	3.0	.9	511,229

Source: (*62*).

Table 6—Distribution of farms growing soybeans, by value of sales, 1982

Region	Value of sales					Total farms
	$100,000 or more	$40,000 to $99,999	$20,000 to $39,999	$10,000 to $19,999	Less than $10,000	
	Percent					*Number*
Lake States	24.1	28.4	17.9	12.8	16.7	59,429
Corn Belt	25.3	27.6	17.2	13.2	16.7	260,092
Northern Plains	26.1	32.4	19.1	11.8	10.6	48,908
Southern Plains	34.1	26.5	15.2	10.7	13.5	5,045
Appalachia	17.6	18.9	16.3	15.6	31.7	60,512
Southeast	21.3	18.5	13.6	14.0	32.7	35,183
Delta	30.6	20.1	12.6	11.5	25.1	30,453
Other	29.1	18.7	13.6	13.1	25.5	11,336
United States	24.5	25.8	16.7	13.2	19.7	510,958

Source: (*62*).

Figure 3

Soybean farms, 1982

individual proprietorships, 13 percent are partnerships, and 3 percent are corporations. The Delta, where there is a high proportion of farms with large acreage and large value of sales, has the largest proportion of corporate farms.

Tenure of Operator. The national tenure distribution of soybean producers is 36 percent full owners, 46 percent part owners, and 18 percent tenants, but the regional distributions deviate from this pattern (table 9). Part-owner status was the most frequent in all regions and showed the least variation across regions. In all regions, except the Southern Plains, full owners were more common than tenants.

Irrigation by Soybean Producers. In 1982, 16,176 farms irrigated 2.32 million acres of soybeans, representing 3.2 percent of the farms harvesting soybeans and 3.7 percent of the Nation's soybean acreage (table 10). Regions were quite different in their use of irrigation because of differences in soil type, climate, and water availability. The largest number of farms reporting irrigation was in the Northern Plains. The Corn Belt and Appalachia had virtually no soybean irrigation, while in the Southern Plains, 41 percent of the soybean-harvesting farms irrigated. The average number of soybean acres irrigated by farms reporting irrigation varied from 61 acres in Appalachia to 264 acres in the Delta.

Supply

The total U.S. soybean supply consists of the current year's production plus the carryin from the previous year (table 11). (Carryin is also referred to as the previous year's ending stocks and the current year's beginning stocks.) The record soybean production in 1979 led to the largest carryover ever, 359 million bushels beginning stocks for the 1980/81 marketing year. Total supply has averaged 2,259 million bushels in the 1980's, and carryin has averaged 328 million bushels. The 1969 carryin, 326.8 million bushels, amounted to about 22 percent of the U.S. soybean supply, the largest relative carryin between 1950 and 1986. Soybean imports are insignificant. They have never amounted to more than 500,000 bushels in any of the last 30 years.

Production Adjustments

U.S. soybean production and its location are determined in part by (1) foreign (world) oilseed supply and demand conditions, (2) U.S. agricultural commodity, trade, and land-use policies, and (3) domestic demand conditions and production practices. Biological advances that substantially increase soybean yields and discoveries of new uses for soybean products will also affect soybean production.

Table 7—Characteristics of specialized soybean farms, 1982

Region	Farms	Average harvested cropland	Average capital assets	Average value of sales
	Number	*Acres*	*Dollars*	
Lake States	12,266	166	332,305	28,102
Corn Belt	60,964	186	381,882	33,335
Northern Plains	6,113	243	392,984	35,196
Southern Plains	1,017	402	679,697	49,255
Appalachia	17,193	160	279,753	27,196
Southeast	13,818	186	336,387	27,304
Delta	15,454	396	618,215	63,468
Other	2,780	127	343,850	19,750
United States	129,607	209	381,726	34,906

Source: (*62*).

Table 8—Farms growing soybeans, by type of organization, 1982

Region	Individual proprietorship	Partnership	Corporation	Other	Total farms
	Percent				*Number*
Lake States	86.6	11.4	1.8	0.3	59,429
Corn Belt	83.6	13.1	2.9	.4	260,092
Northern Plains	86.4	10.2	3.1	.3	48,908
Southern Plains	83.5	12.1	4.0	.4	5,045
Appalachia	84.0	13.9	1.7	.3	60,512
Southeast	85.4	12.1	2.1	.5	35,183
Delta	81.2	12.7	5.4	.6	30,453
Other	82.6	12.9	4.1	.4	11,336
United States	84.2	12.6	2.8	.4	510,958

Source: (*62*).

Table 9—Tenure of soybean producers, 1982

Region	Full owner	Part owner	Tenant	Total operators
	Percent			*Number*
Lake States	39.8	44.7	15.5	59,429
Corn Belt	36.5	43.6	20.0	260,092
Northern Plains	27.5	52.4	20.1	48,908
Southern Plains	24.1	51.1	24.8	5,045
Appalachia	39.9	46.2	13.9	60,512
Southeast	37.2	49.9	12.9	35,183
Delta	30.3	47.8	21.9	30,453
Other	36.6	47.8	15.5	11,336
United States	36.0	45.7	18.3	510,958

Source: (*62*).

Table 10—Soybean irrigation, by region, 1982

Region	Irrigated			Share of —	
	Farms	Cropland	Cropland per farm	Farms	All cropland
	Number	*Acres*		*Percent*	
Lake States	859	76,441	89	1.5	1.3
Corn Belt	1,833	250,660	137	.7	.8
Northern Plains	6,638	617,943	93	13.6	12.4
Southern Plains	2,067	334,147	162	40.8	33.9
Appalachia	228	13,899	61	.4	.2
Southeast	1,165	179,816	154	3.3	3.4
Delta	3,132	827,545	264	10.3	8.0
United States	16,176	2,321,138	143	3.2	3.6

Source: (*62*).

Table 11—U.S. soybean supplies

Year	Production	Beginning stocks	Total
	Million bushels		
1950	299.2	2.9	302.2
1951	283.8	4.2	287.9
1952	298.8	3.6	302.4
1953	269.2	22.4	291.4
1954	341.1	8.1	349.2
1955	373.7	22.6	396.3
1956	449.3	21.0	470.3
1957	483.4	31.6	515.0
1958	580.2	42.8	623.0
1959	532.9	87.8	620.7
1960	555.1	51.8	606.9
1961	678.6	27.1	705.7
1962	669.2	78.3	747.5
1963	699.2	46.0	745.5
1964	700.9	67.3	768.2
1965	845.6	29.7	875.3
1966	928.5	35.6	964.1
1967	976.1	90.1	1,066.2
1968	1,107.0	166.3	1,273.3
1969	1,133.1	326.8	1,460.0
1970	1,127.1	229.8	1,356.9
1971	1,176.1	98.8	1,274.9
1972	1,270.1	72.0	1,342.6
1973	1,547.5	59.6	1,607.2
1974	1,216.3	170.8	1,387.0
1975	1,548.3	188.2	1,736.5
1976	1,288.6	244.9	1,533.5
1977	1,767.3	102.9	1,870.2
1978	1,868.8	161.2	2,029.9
1979	2,260.7	176.0	2,436.7
1980	1,797.5	358.8	2,156.3
1981	1,989.1	313.0	2,302.1
1982	2,190.3	254.0	2,444.3
1983	1,635.8	345.0	1,980.8
1984	1,860.9	176.0	2,036.9
1985	2,098.5	316.0	2,414.5
1986	1,940.1	536.0	2,476.1

Source: (*50, 60*).

Among the foreign events expected to affect U.S. production are trade policy decisions of the European Community, Japan, and centrally planned economies; Brazil's and Argentina's success in establishing soybean production, processing, and export industries; and the expansion of palm oil, rapeseed, and other competing foreign oilseed industries.

Important U.S. policies influencing soybean production include those affecting the relative profitability of soybeans and competing crops; conservation programs that encourage producers to plant on only the most productive, least erodible land; direct trade policy decisions, including embargoes and carrier requirements; and indirect macroeconomic policies affecting exchange rates and interest rates.

Domestic demand influences that might ultimately affect production decisions include population and income growth rates and shifts in demand toward or away from commodities produced with soybeans. Production practices affecting soybean production include adoption of reduced tillage methods, crop rotation schemes, and double cropping.

Acreage expansion is possible in all regions. The specific regions most likely to expand will depend on soybean's competitiveness with other crops within each region. The Northern and Southern Plains are not prime sites for expansion because of their dependence on irrigation and their relatively small acreage expansion since 1950.

Costs and Returns

The data in table 12 are estimates of costs and returns per planted acre from soybean production for 1983, 1984, and 1985. Cash receipts are current-year returns or revenues based on harvest-period prices and average yield per planted acre. Government payments are excluded from receipts.

Total returns from soybean production vary from year to year because prices and yields change. Soybean returns fell from $204.46 per acre in PIK year 1983 to a more typical $166.72 per acre in 1984. Although U.S. average soybean yields per planted acre increased slightly between 1983 and 1984, per acre returns decreased substantially because soybean prices fell from $7.95 to $6.05 per bushel. Yields rose and prices fell again in 1985, maintaining per acre cash receipts near 1984 levels.

The cost of producing soybeans varies from year to year because input prices and quantities of inputs used change. Cash expenses are divided into variable expenses and fixed expenses. Variable expenses are incurred only when production occurs, while fixed expenses are incurred whether or not production takes place. The largest variable cash expense in soybean production in 1983–85 was chemicals followed by fuel, seed, and fertilizer. Among fixed expenses, interest was much larger than general farm overhead, taxes, and insurance combined.

The economic costs section of table 12 includes a value placed on inputs and resources used in production without regard to ownership of the resource. Subtracting variable expenses, general farm overhead, taxes and insurance, and capital replacement from cash receipts leaves net returns to owned inputs consisting of land, labor, and capital. These returns fell from almost $100 in 1983 to less than $62 in 1984 and 1985.

USDA also estimates costs and returns from producing soybeans by region (tables 13–16). (The cost of production estimates use differently defined regions than are used elsewhere in this report.) Variable costs are highest in the Southeast and lowest in the Northern Plains. Most of the differences in variable costs between these regions result from differences in outlays for fertilizer and chemicals. Fixed costs are highest in the Lake States and Corn Belt regions and lowest in the Delta and Southeast regions. The cost difference arises because of higher taxes, insurance, and interest expenses in the Lake States and Corn Belt. The biggest difference between regions in allocated returns to owned inputs is in net land rent which is highest in the Lake States and Corn Belt and lowest in the Southeast.

Soybean Use

Soybeans are crushed to produce joint products of meal and oil. About 55 percent of the crop is normally crushed, while most of the balance is exported (table 17). About 62 percent of the value of soybeans normally comes from meal and 38 percent from oil.

Meal

Soybean meal is used primarily as a high-protein livestock feed. Only 1–2 percent of the meal is used to produce food protein. The supply and disappearance of U.S. soybean meal are shown in table 18. During the first half of the 1980's, about a fourth of the domestically produced meal was exported.

Soybean meal is the major high-protein feed fed in the United States, increasing from 57 percent of the total protein fed in 1965/66 to 75 percent in 1984/85, on a 44-percent crude protein basis. During the same

period, soybean meal, as a percentage of total oil meals fed, increased from 80 percent to 89 percent.

From 1980/81 to 1985/86, poultry consumed about 45 percent of the soybean meal, with broilers accounting for nearly half of this amount (table 19). Hogs consumed over 30 percent of the soybean meal. Beef cattle and milk cows each consumed slightly less than 10 percent.

Oil

During the first half of the 1980's, 16 percent of the soybean oil produced in the United States was exported (table 20). Exports varied from 14 percent in 1980 and 1984 to 19 percent in 1981, reflecting differences in world supply and demand.

Soybean oil is the dominant vegetable oil used domestically in edible oil products. Since 1960, soybean oil and cottonseed oil have comprised about 75 percent of the total fats and oils used in edible oil products (table 21). The striking difference between the two oils is that the proportion of cottonseed oil used declined from 22 percent in 1960 to 4 percent in 1985/86 while soybean oil used increased from 54 percent to 72 percent.[2] The proportional use of other fats and oils has remained fairly stable, except for

[2] Bureau of the Census started reporting annual tables on a marketing year (Oct.–Sept.) basis in 1978/79.

Table 12—U.S. soybean production costs

Item	1983	1984	1985
		Dollars per planted acre	
Cash receipts	204.46	166.72	162.72
Cash expenses:			
Seed	7.98	10.08	8.74
Fertilizer	7.58	7.70	6.84
Lime and gypsum	1.16	1.15	1.12
Chemicals	19.18	18.35	17.47
Custom operations	3.84	3.85	3.86
Fuel, lube, and electricity	10.35	8.43	7.58
Repairs	6.63	6.64	6.49
Hired labor	1.47	1.47	1.50
Miscellaneous	.34	.35	.34
Technical services	.18	.16	.15
Total, variable expenses	58.71	58.18	54.10
General farm overhead	10.43	10.81	10.91
Taxes and insurance	11.18	11.77	12.16
Interest	32.57	33.82	33.23
Total, fixed expenses	54.18	56.40	56.30
Total, cash expenses	112.89	114.58	110.40
Receipts less cash expenses	91.57	52.14	52.32
Capital replacement	24.50	24.13	23.80
Receipts less cash expenses and replacement	67.07	28.01	28.52
Economic (full ownership) costs:			
Variable expenses	58.71	58.18	54.10
General farm overhead	10.43	10.81	10.91
Taxes and insurance	11.18	11.77	12.16
Capital replacement	24.50	24.13	23.80
Allocated returns to owned inputs—			
Returns to operating capital	2.21	2.47	1.81
Returns to other nonland capital	8.22	8.08	8.06
Net land rent	63.46	52.99	48.80
Unpaid labor	9.82	9.84	10.07
Total, economic costs	188.53	178.27	169.71
Residual returns to management and risk	15.93	−11.55	−6.99
Total, returns to owned inputs	99.64	61.83	61.75
		Dollars per bushel	
Harvest-period price	7.95	6.05	4.86
		Bushels per planted acre	
Yield	25.72	27.54	33.45

Source: (*52*).

Table 13—Soybean production costs, Southeast [1]

Item	1983	1984	1985
		Dollars per planted acre	
Cash receipts	137.72	141.46	124.39
Cash expenses:			
Seed	7.25	9.96	8.20
Fertilizer	16.31	14.73	13.38
Lime and gypsum	3.94	4.03	4.06
Chemicals	22.11	20.82	19.79
Custom operations	5.65	5.73	5.89
Fuel, lube, and electricity	10.96	8.98	8.22
Repairs	7.47	7.45	7.28
Hired labor	1.62	1.59	1.60
Miscellaneous	.21	.21	.21
Technical services	.24	.24	.23
Total, variable expenses	75.76	73.74	68.87
General farm overhead	6.05	6.23	6.21
Taxes and insurance	5.10	5.27	5.55
Interest	20.45	19.38	18.78
Total, fixed expenses	31.60	30.88	30.54
Total, cash expenses	107.36	104.62	99.41
Receipts less cash expenses	30.36	36.84	24.98
Capital replacement	20.43	20.72	20.27
Receipts less cash expenses and replacement	9.93	16.12	4.71
Economic (full ownership) costs:			
Variable expenses	75.76	73.74	68.87
General farm overhead	6.05	6.23	6.21
Taxes and insurance	5.10	5.27	5.55
Capital replacement	20.43	20.72	20.27
Allocated returns to owned inputs—			
Returns to operating capital	3.11	3.39	2.50
Returns to other nonland capital	6.58	6.52	6.44
Net land rent	27.03	27.88	25.36
Unpaid labor	10.88	10.63	10.74
Total, economic costs	154.94	154.38	145.94
Residual returns to management and risk	−17.22	−12.92	−21.55
Total, returns to owned inputs	30.38	35.50	23.49
		Dollars per bushel	
Harvest-period price	7.79	6.07	5.04
		Bushels per planted acres	
Yield	17.67	23.29	24.67

[1] Southeast includes Virginia, North Carolina, South Carolina, Georgia, Alabama, Tennessee, and Kentucky. Source: (*52*).

Table 14—Soybean production costs, Delta [1]

Item	1983	1984	1985
		Dollars per planted acre	
Cash receipts	158.68	154.29	122.50
Cash expenses:			
Seed	7.67	10.78	10.00
Fertilizer	4.92	5.83	5.29
Lime and gypsum	.41	.43	.40
Chemicals	20.82	19.17	18.19
Custom operations	4.89	4.98	5.12
Fuel, lube, and electricity	11.01	8.82	8.01
Repairs	7.20	7.21	7.10
Hired labor	1.58	1.56	1.54
Miscellaneous	.86	.88	.87
Technical services	.44	.44	.41
Total, variable expenses	59.80	60.09	56.93
General farm overhead	7.10	7.23	7.19
Taxes and insurance	4.69	4.99	5.18
Interest	14.48	18.36	17.69
Total, fixed expenses	26.27	30.58	30.06
Total, cash expenses	86.07	90.67	86.99
Receipts less cash expenses	72.61	63.62	35.51
Capital replacement	22.56	23.30	22.84
Receipts less cash expenses and replacement	50.05	40.32	12.67

—Continued—

Table 14—Soybean production costs, Delta [1]—Continued

Item	1983	1984	1985
Economic (full ownership) costs:			
Variable expenses	59.80	60.09	56.93
General farm overhead	7.10	7.23	7.19
Taxes and insurance	4.69	4.99	5.18
Capital replacement	22.56	23.30	22.84
Allocated returns to owned inputs—			
Returns to operating capital	2.39	2.82	2.09
Returns to other nonland capital	7.30	7.29	7.22
Net land rent	33.19	33.44	27.33
Unpaid labor	10.55	10.40	10.32
Total, economic costs	147.58	149.57	139.10
Residual returns to management and risk	11.10	4.72	-16.60
Total, returns to owned inputs	64.53	58.68	30.36
		Dollars per bushel	
Harvest-period price	7.86	6.20	5.01
		Bushels per planted acre	
Yield	20.20	24.88	24.47

[1] Delta includes Mississippi, Louisiana, and Arkansas. Source: (*52*).

Table 15—Soybean production costs, Northern Plains [1]

Item	1983	1984	1985
		Dollars per planted acre	
Cash receipts	185.69	125.65	151.45
Cash expenses:			
Seed	6.11	8.97	7.43
Fertilizer	3.26	2.68	2.50
Lime and gypsum	.12	.12	.11
Chemicals	13.73	13.43	12.85
Custom operations	3.40	3.57	3.71
Fuel, lube, and electricity	9.87	8.60	8.13
Repairs	7.45	7.50	7.47
Hired labor	1.42	1.51	1.58
Miscellaneous	.04	.04	.04
Total, variable expenses	45.40	46.42	43.82
General farm overhead	11.26	11.87	12.11
Taxes and insurance	11.20	11.73	12.43
Interest	32.57	31.92	31.53
Total, fixed expenses	55.03	55.52	56.08
Total, cash expenses	100.43	101.94	99.90
Receipts less cash expenses	85.26	23.71	51.55
Capital replacement	20.44	20.57	20.45
Receipts less cash expenses and replacement	64.82	3.14	31.10
Economic (full ownership) costs:			
Variable expenses	45.40	46.42	43.82
General farm overhead	11.26	11.87	12.11
Taxes and insurance	11.20	11.73	12.43
Capital replacement	20.44	20.57	20.45
Allocated returns to owned inputs—			
Returns to operating capital	1.59	1.84	1.37
Returns to other nonland capital	7.78	7.69	7.70
Net land rent	56.86	37.78	42.30
Unpaid labor	9.50	10.10	10.57
Total, economic costs	164.03	148.00	150.75
Residual returns to management and risk	21.66	-22.35	.70
Total, returns to owned inputs	97.39	35.06	62.64
		Dollars per bushel	
Harvest-period price	7.98	5.83	4.68
		Bushels per planted acre	
Yield	23.27	21.56	32.38

[1] Northern Plains includes South Dakota, Nebraska, and Kansas. Source: (*52*).

lard which has declined from 10 percent of total fats and oils in 1960 to 3 percent in 1985/86. Also, palm oil use has increased in response to a favorable price differential in relation to soybean oil in the mid-1970's.

Total fats and oils consumed in salad and cooking oils increased 370 percent between 1960 and 1985/86. The share of soybean oil used in salad and cooking oils increased even faster, from 46 percent to 78 percent (table 22).

Fats and oils consumed in baking and frying fats increased 250 percent between 1960 and 1985/86. The amount of soybean oil used in baking and frying fats increased at a faster rate, resulting in the proportion of total fats and oils accounted for by soybean oil increasing from 51 percent to 62 percent.

Soybean oil, as a proportion of total fats and oils used in margarine, has remained around 80 percent since 1960. The amount of fats and oils consumed in margarine has increased nearly 40 percent.

Table 16—Soybean production costs, Lake States and Corn Belt [1]

Item	1983	1984	1985
		Dollars per planted acre	
Cash receipts	239.93	183.28	183.15
Cash expenses:			
Seed	8.54	10.09	8.75
Fertilizer	6.20	6.90	6.13
Lime and gypsum	.65	.65	.68
Chemicals	18.57	18.16	17.33
Custom operations	3.05	3.05	3.08
Fuel, lube, and electricity	10.04	8.15	7.25
Repairs	6.11	6.14	6.03
Hired labor	1.40	1.41	1.46
Miscellaneous	.27	.27	.27
Technical services	.11	.11	.10
Total, variable expenses	54.94	54.93	51.08
General farm overhead	12.57	12.89	12.80
Taxes and insurance	14.81	15.39	15.41
Interest	41.22	42.23	40.68
Total, fixed expenses	68.60	70.51	68.89
Total, cash expenses	123.54	125.44	119.98
Receipts less cash expenses	116.39	57.84	63.17
Capital replacement	26.81	25.85	25.35
Receipts less cash expenses and replacement	89.58	31.99	37.82
Economic (full ownership) costs:			
Variable expenses	54.94	54.93	51.08
General farm overhead	12.57	12.89	12.80
Taxes and insurance	14.81	15.39	15.41
Capital replacement	26.81	25.85	25.35
Allocated returns to owned inputs—			
Returns to operating capital	1.97	2.21	1.63
Returns to other nonland capital	9.03	8.79	8.71
Net land rent	83.77	67.48	60.52
Unpaid labor	9.34	9.44	9.77
Total, economic costs	213.24	196.98	185.28
Residual returns to management and risk	26.69	– 13.70	– 2.13
Total, returns to owned inputs	130.80	74.22	78.50
		Dollars per bushel	
Harvest-period price	7.99	6.04	4.84
		Bushels per planted acre	
Yield	30.01	30.33	37.88

[1] Lake States are Minnesota, Wisconsin, and Michigan. Corn Belt includes Iowa, Missouri, Illinois, Indiana, and Ohio.
Source: (52).

Overall, the fats and oils consumed in edible fats and oils products more than doubled between 1960 and 1985/86. The use of soybean oil in these products increased at a faster rate, going from 54 percent to 72 percent.

The dominant use of soybean oil is in salad and cooking oils, followed by baking and frying fats and margarine. In 1960, the use of soybean oil in salad and cooking oils ranked third behind the use in baking and frying fats and margarine (table 23). Forty-seven percent of the soybean oil consumed in the United States is going into salad and cooking oils, compared with only 26 percent in 1960. This rise is offset by a decline in the proportion used in margarine (from 32 percent to 17 percent). The decline in proportional use in margarine reflects the slower growth in margarine consumption and the fact that soybean oil became the dominant oil used in margarine before 1960.

Soybean oil use in inedible products has declined from 6 percent in 1960 to only 2 percent in 1985/86. Inedible uses include paint or varnish, fatty acids, and resins and plastics.

Soybean Prices

Soybean prices depend on the interaction of supply and demand in the marketplace as well as the effects of Government programs. The weather, world demand for soybeans, changes in Government policy, and the value of the dollar in relation to other currencies, among other things, can upset the supply-demand balance, causing wide swings in soybean prices.

Table 17—Soybeans supply and use

Year [1]	Supply	Crush	Exports	Other [2]	Total use	Ending stocks
	Million bushels					
1955	396	282	69	24	375	21
1956	471	314	84	41	439	32
1957	515	351	88	33	472	43
1958	623	399	105	31	535	88
1959	621	394	140	35	569	52
1960	607	406	135	39	580	27
1961	706	432	149	47	628	78
1962	748	473	181	48	702	46
1963	745	437	187	54	678	67
1964	768	479	212	47	738	30
1965	876	537	251	52	840	36
1966	964	559	262	53	874	90
1967	1,066	576	267	57	900	166
1968	1,273	606	287	53	946	327
1969	1,460	737	433	60	1,230	230
1970	1,357	760	434	64	1,258	99
1971	1,275	721	417	65	1,203	72
1972	1,343	722	479	82	1,283	60
1973	1,607	821	539	76	1,436	171
1974	1,387	701	421	77	1,199	188
1975	1,736	865	555	71	1,491	245
1976	1,534	790	564	77	1,431	103
1977	1,870	927	700	82	1,709	161
1978	2,030	1,018	739	97	1,854	176
1979	2,437	1,123	875	81	2,079	358
1980	2,156	1,020	724	99	1,843	313
1981	2,302	1,030	929	89	2,048	254
1982	2,444	1,108	905	86	2,099	345
1983	1,981	983	743	79	1,805	176
1984	2,037	1,030	598	93	1,721	316
1985	2,415	1,053	740	86	1,879	536
1986	2,476	1,179	757	104	2,040	436

[1] Year beginning September 1.
[2] Seed, feed, and residual.
Source: (55).

Table 18—Soybean meal: Supply and disappearance

Year beginning October 1	Supply					Disappearance			
	Stocks [1]	Production			Total	Exports	Domestic	Total	Ending Stocks
		Total	For—						
			Animal feed	Edible protein					
	1,000 short tons								
1960	83	9,452	NA	NA	9,535	590	8,867	9,457	78
1961	78	10,342	NA	NA	10,420	1,064	9,262	10,326	94
1962	94	11,127	NA	NA	11,221	1,475	9,586	11,061	159
1963	159	10,609	NA	NA	10,768	1,479	9,167	10,646	122
1964	122	11,286	NA	NA	11,408	2,036	9,265	11,301	106
1965	106	12,901	NA	NA	13,007	2,604	10,271	12,875	132
1966	132	13,483	NA	NA	13,615	2,657	10,820	13,477	138
1967	138	13,660	NA	NA	13,798	2,899	10,753	13,652	145
1968	145	14,581	NA	NA	14,726	3,044	11,525	14,569	157
1969	157	17,596	NA	NA	17,753	4,035	13,581	17,616	137
1970	137	18,035	NA	NA	18,172	4,559	13,467	18,026	146
1971	146	17,024	NA	NA	17,170	3,805	13,173	16,978	192
1972	192	16,709	NA	NA	16,901	4,745	11,972	16,717	183
1973	183	19,674	NA	NA	19,857	5,548	13,802	19,350	507
1974	507	16,702[2]	16,436	265	17,209	4,299	12,551	16,850	358
1975	358	20,754	20,395	359	21,112	5,145	15,612	20,757	355
1976	355	18,488	18,100	388	18,843	4,559	14,056	18,615	228
1977	228	22,371	21,961	410	22,599	6,080	16,276	22,356	243
1978	243	24,354	23,986	368	24,597	6,610	17,720	24,330	267
1979	267	27,105	26,808	297	27,372	7,932	19,214	27,146	226
1980	226	24,312	24,026	286	24,538	6,784	17,591	24,375	163
1981	163	24,634	24,326	308	24,797	6,908	17,714	24,622	175
1982	175	26,714	26,411	303	26,889	7,109	19,306	26,415	474
1983	474	22,756	22,489	267	23,230	5,360	17,615	22,975	255
1984	255	24,529	24,262	267	24,784	4,917	19,480	24,397	387
1985	387	24,951	24,691	260	25,338	6,008	19,118	25,126	212
1986	212	27,758	NA	NA	27,970	7,300	20,430	27,730	240

NA = not available.

[1] Stocks at processor plants.

[2] In January 1975, soybean crushers started reporting the breakdown of soybean meal production between that for animal feed and edible protein.

Source: (*55, 64*).

Table 19—Soybean meal consumed, by livestock class for selected years [1]

Item	1965	1970	1975	1980	1981	1982	1983	1984	1985
	Million metric tons								
Dairy animals	1.0	1.0	1.6	1.5	1.5	1.6	1.5	1.7	1.7
Cattle on feed	.4	.9	1.2	.6	.6	.9	.6	.8	.9
Other beef cattle	.3	.6	.7	.8	.8	.9	.9	.7	.8
Hens, pullets, and chickens raised	1.9	2.2	2.7	2.6	2.7	2.9	2.7	1.8	1.9
Broilers	1.4	1.9	2.4	3.3	3.3	3.5	3.4	4.0	4.1
Turkeys	.6	.8	1.0	1.3	1.2	1.8	1.3	1.6	1.8
Hogs	3.3	4.3	5.1	4.9	5.2	5.4	4.4	4.6	5.2
Other	.4	.5	.5	.6	.6	.6	.7	2.5	1.8
Total	9.3	12.2	15.2	15.6	16.1	17.6	15.5	17.7	18.2

[1] Years beginning October 1.

Source: (*54*).

Table 20—Soybean oil: Supply and disappearance

Year beginning October 1	Supply			Disappearance			
	Beginning stocks	Production	Total	Exports	Domestic[1]	Total	Ending stocks
	Million pounds						
1960	308	4,420	4,728	721[2]	3,330	4,051	677
1961	677	4,790	5,467	1,309[2]	3,540	4,849	618
1962	618	5,091	5,709	1,165[2]	3,624	4,789	920
1963	920	4,822	5,742	1,106[2]	4,058	5,164	578
1964	578	5,146	5,724	1,340[2]	4,087	5,427	297
1965	297	5,800	6,097	923	4,712	5,635	462
1966	462	6,076	6,538	1,077	4,865	5,942	596
1967	596	6,032	6,628	963	5,125	6,088	540
1968	540	6,531	7,071	870	5,786	6,656	415
1969	415	7,904	8,319	1,419	6,357	7,776	543
1970	543	8,265	8,808	1,743	6,292	8,035	773
1971	773	7,892	8,665	1,398	6,482	7,880	785
1972	785	7,501	8,286	1,066	6,704	7,770	516
1973	516	8,995	9,511	1,436	7,280	8,716	794
1974	794	7,375	8,169	1,028	6,580	7,608	561
1975	561	9,630	10,191	976	7,964	8,940	1,251
1976	1,251	8,578	9,829	1,547	7,511	9,058	771
1977	771	10,288	11,059	2,057	8,273	10,330	729
1978	729	11,323	12,052	2,334	8,942	11,276	776
1979	776	12,105	12,881	2,690	8,891	11,671	1,210
1980	1,210	11,270	12,480	1,631	9,113	10,744	1,736
1981	1,736	10,979	12,715	2,077	9,536	11,612	1,103
1982	1,103	12,040	13,143	2,025	9,857	11,882	1,261
1983	1,261	10,872	12,133	1,824	9,588	11,412	721
1984	721	11,468	12,209	1,660	9,917	11,577	632
1985	632	11,617	12,257	1,257	10,053	11,310	947

[1] Includes shipments to U.S. territories.
[2] Includes estimates of foreign donations of fats and oils, not reported by the Bureau of the Census, 1960–64.
Source: (*55, 64*).

Table 21—Market share of selected fats and oils in edible oil products

Product	1960	1965	1970	1975	1980/81[1]	1984/85	1985/86
	Percent						
Soybean oil	54	56	65	66	72	74	72
Cottonseed oil	22	19	10	6	5	4	4
Corn oil	5	D	D	5	5	6	5
Peanut oil	1	1	2	1	1	1	1
Lard	9	7	6	2	3	2	3
Edible tallow	5	5	6	6	6	7	7
Coconut oil	3	3	4	4	3	2	3
Palm oil	D	D	D	7	2	2	3
Sunflower oil	NA	NA	NA	NA	1	1	1

D = Bureau of the Census withheld data to avoid disclosing figures for individual companies.
NA = Not available.
[1] Census started reporting annual tables on a marketing year (Oct.–Sept.) basis in 1978/79.
Source: (*55, 65*).

Table 22—Soybean oil consumed in end products and share of total fats and oils consumed

Product	1960		1970		1975	
	Soybean oil	Share of total fats and oils	Soybean oil	Share of total fats and oils	Soybean oil	Share of total fats and oils
	Million pounds	*Percent*	*Million pounds*	*Percent*	*Million pounds*	*Percent*
Baking and frying fats	1,169	51	2,182	61	2,025	54
Salad and cooking oils	887	46	2,470	73	3,031	76
Margarine	1,105	81	1,409	79	1,568	82
Other products	27	10	38	8	22	5
Edible	3,188	54	6,099	65	6,646	66
Inedible	218	5	223	4	184	4
Total	3,406	34	6,322	44	6,830	46
	1980/81 [1]		1984/85		1985/86	
	Soybean oil	Share of total fats and oils	Soybean oil	Share of total fats and oils	Soybean oil	Share of total fats and oils
	Million pounds	*Percent*	*Million pounds*	*Percent*	*Million pounds*	*Percent*
Baking and frying fats	2,675	63	3,654	67	3,440	62
Salad and cooking oils	4,226	80	4,800	80	4,686	78
Margarine	1,666	82	1,589	83	1,735	85
Other products	43	11	129	34	138	35
Edible	8,610	72	10,172	74	10,004	72
Inedible	202	4	251	5	280	5
Total	8,812	50	10,423	55	10,284	53

[1] Bureau of the Census started reporting annual tables on a marketing year (Oct.–Sept.) basis in 1978/79.
Source: (*55, 65*).

Historical Trends

Soybean prices followed a moderate upward trend through the 1960's, but prices increased sharply in the 1970's as the demand for exports grew dramatically. For example, average farm prices of soybeans rose from $2.13 per bushel for the 1960/61 marketing year to $2.85 for 1970/71 and to $7.57 per bushel for 1980/81 (table 24). Farm prices of soybeans have fluctuated in the 1980's, rising as high as $7.81 per bushel for 1983/84 while falling the following year to $5.78.

Marked year-to-year fluctuations have characterized price behavior since the early 1970's. Major forces contributing to the sharp price increases in the 1970's included foreign soybean crop failures, unfavorable weather in the United States, favorable exchange rates, and strong economic growth in importing countries (*53*).

Seasonal Farm Prices. Soybean farm prices are usually lowest in October, November, and December when the majority of the crop is harvested and then rise throughout the marketing year. The monthly change in farm prices throughout the rest of the year usually reflects the carrying charge. The carrying charge includes the physical costs of storage, interest, taxes, insurance, and risk premiums (*22*). Changes in market information (for example, information concerning the size of the Brazilian soybean crop) will affect the current price and prices in subsequent months of the marketing year.

Table 23—Proportion of soybean oil used in various edible oil products

Product	1960	1970	1975	1980/81 [1]	1984/85	1985/86
	Percent					
Baking and frying fats	34	35	30	30	35	34
Salad and cooking oils	26	39	44	48	46	47
Margarine	32	22	23	19	15	17
Other edible products	1	1	[2]	[2]	1	2

[1] Census started reporting annual tables on a marketing year (Oct.–Sept.) basis in 1978/79.
[2] Less than 0.5 percent.
Source: (*55, 65*).

Although prices are tied together by storage within the crop year, prices between crop years do not usually reflect carrying charges. Thus, there is little economic incentive to hold stocks into the new crop year except for pipeline purposes; that is, for normal operating inventories and quantities in transit.

Table 24 shows the intraseasonal price movements during marketing years 1960/61–85/86. Monthly prices generally rise over the marketing year by approximately equal amounts; however, there are important exceptions. Marked changes in seasonal prices of soybeans occurred during most years of the 1970's, reflecting the large shocks in foreign supply and export demand. The largest change occurred during the 1972/73 marketing year when soybean prices rose from $3.13 per bushel in October 1972 to a record high $10 in June 1973 (table 24). Prices fell the following month to $6.69 per bushel in response to the embargo placed by President Nixon on soybean exports (*53*).

Discounts and Premiums. Grade standards provide the market with a method of describing selected characteristics of a quantity of soybeans (app. B). The market assigns values to these factors in the form of discounts and premiums. Price differentials are based on supply and demand conditions, costs in changing the grade, and estimated value of end use. Quality discounts may adjust to changing conditions and hence vary over time and between localities (*26*).

Price discounts are established for each factor and applied whenever a sample of soybeans fails to meet the quality of the base price grade. The base grade for soybeans is No. 1.

Hill found that price discounts vary from firm to firm and do not necessarily correspond to grade standards (*26*). Grade standards allow for 10 percent splits (soybeans with more than a fourth of the bean removed), but only one-third of the firms in Hill's surveys reported discounts for splits. Firms compensate for moisture content above 13 percent by a combination of shrink tables or discount as a percentage of price. Firms reported that they reduce the purchase price (dockage) when foreign material exceeds 1 percent.

Table 24—Monthly and annual U.S. average soybean prices received, by farmers

Year beginning September 1	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Average [1]
	Dollars per bushel												
1960/61	1.97	1.94	1.96	1.99	2.23	2.48	2.68	3.02	2.96	2.60	2.48	2.49	2.13
1961/62	2.24	2.20	2.27	2.30	2.32	2.32	2.34	2.38	2.36	2.34	2.35	2.33	2.28
1962/63	2.25	2.23	2.30	2.35	2.41	2.50	2.51	2.45	2.47	2.48	2.44	2.45	2.34
1963/64	2.44	2.56	2.66	2.58	2.65	2.57	2.55	2.45	2.36	2.35	2.34	2.35	2.51
1964/65	2.51	2.55	2.57	2.71	2.73	2.81	2.85	2.85	2.72	2.74	2.69	2.53	2.62
1965/66	2.35	2.31	2.36	2.48	2.67	2.77	2.71	2.78	2.90	3.04	3.37	3.49	2.54
1966/67	2.97	2.78	2.80	2.82	2.77	2.71	2.74	2.71	2.69	2.71	2.66	2.56	2.75
1967/68	2.53	2.44	2.43	2.48	2.53	2.57	2.57	2.56	2.58	2.54	2.52	2.51	2.49
1968/69	2.40	2.32	2.40	2.42	2.46	2.48	2.48	2.51	2.56	2.52	2.52	2.51	2.43
1969/70	2.28	2.23	2.30	2.30	2.36	2.40	2.42	2.48	2.52	2.60	2.72	2.65	2.35
1970/71	2.66	2.77	2.86	2.77	2.86	2.92	2.91	2.80	2.85	2.98	3.18	3.09	2.85
1971/72	2.95	2.96	2.84	2.93	2.92	3.00	3.20	3.37	3.35	3.32	3.34	3.36	3.03
1972/73	3.26	3.13	3.38	3.95	4.11	5.49	6.04	6.14	8.27	10.00	6.69	8.99	4.37
1973/74	5.81	5.63	5.14	5.65	5.87	6.07	5.96	5.15	5.21	5.13	6.11	7.55	5.68
1974/75	7.32	8.17	7.44	7.03	6.30	5.72	5.31	5.60	5.00	4.90	5.28	5.80	6.64
1975/76	5.32	4.92	4.45	4.28	4.46	4.50	4.46	4.52	4.87	6.16	6.73	6.07	4.92
1976/77	6.65	5.90	6.11	6.56	6.81	7.06	7.83	9.05	9.24	8.13	6.52	5.48	6.81
1977/78	5.17	5.28	5.61	5.68	5.75	5.53	6.20	6.49	6.77	6.69	6.40	6.21	5.88
1978/79	6.20	6.26	6.41	6.49	6.58	6.99	7.16	7.06	7.06	7.36	7.36	7.07	6.66
1979/80	6.81	6.35	6.30	6.27	6.39	6.20	5.94	5.63	5.76	5.91	6.75	7.18	6.28
1980/81	7.59	7.68	8.18	7.80	7.80	7.50	7.59	7.60	7.40	7.05	7.13	6.71	7.57
1981/82	6.21	6.06	6.03	6.00	6.13	6.04	5.99	6.17	6.27	6.12	5.99	5.59	6.04
1982/83	5.22	5.06	5.34	5.46	5.56	5.66	5.82	6.09	6.06	5.90	6.27	7.57	5.69
1983/84	8.28	7.96	7.81	7.75	7.85	7.28	7.68	7.83	8.12	7.99	6.95	6.50	7.81
1984/85	6.09	6.07	6.01	5.82	5.91	5.77	5.88	5.88	5.70	5.62	5.42	5.10	5.78
1985/86	4.99	4.85	4.92	5.01	5.16	5.18	5.23	5.23	5.25	5.19	5.11	4.99	5.04

[1] Season average price received by farmers weighted by the estimated percentage of the crop sold each month.
Source: (*55, 61*).

Despite variations in oil and meal content of soybeans, these factors are not included in grade standards. Prices paid for soybeans, however, are discounted in certain areas, such as the northern growing areas, because buyers know these soybeans usually contain less oil. Although these factors are not reflected in official grades, new quality standards reflecting oil and protein content may emerge as equipment is developed.

Regional Price Differences. Prices vary by region depending on local market conditions, quality of product, and transportation and handling costs. Regional price differentials are usually minor, although the prices in the Northern and Southern Plains (North and South Dakota, Nebraska, Kansas, Oklahoma, and Texas) tend to be lower than in other regions (table 25). In the 1985/86 marketing year, for example, farm prices of soybeans averaged $5.12 per bushel in the Delta, $5.05 in the Corn Belt, $4.92 in the Lake States, $5.04 in the Southeast, $5.19 in Appalachia, $4.71 in the Southern Plains, and $4.86 in the Northern Plains.

Market/Farm Price Relationships. Soybean prices were relatively stable during the 1960's; however, the situation reversed during the 1970's when prices increased sharply and fluctuated widely from year to year. The sharp upward trend in soybean prices beginning in 1970 followed 4 years of declining prices. For example, cash prices at Illinois processors dropped from $2.91 per bushel in 1965 to $2.53 in 1969. But, after that decline, prices rose to $3.00 per bushel in 1970, $5.26 in 1975, and $7.86 in 1983 before declining to $5.30 in 1985 (table 26). Season average farm prices usually change in the same direction as prices in the central market. However, the magnitude of the price changes differ from year to year, as evidenced by the variability in the market/farm price spread. For example, the large spread in 1972 reflects the fact that dramatic price rises occurred in the latter portion of the year after most farmers had already sold their crop.

Soybean prices have exceeded price support loan rates for most years since soybeans first came under Government price supports. Nevertheless, the loan program has been used by soybean producers as a financial mechanism at harvesttime to obtain cash. The producers can redeem their loans prior to maturity and take advantage of market prices higher than the loan value. In the event of an unexpected price decline, producers can forfeit their soybeans to the Commodity Credit Corporation (CCC).

Table 25—Season average price of soybeans received, by farmers by region [1]

Year [2]	Lake States	Corn Belt	Southeast	Delta	Southern Plains	Northern Plains	Appalachia	United States [3]
	Dollars per bushel							
1965/66	2.56	2.55	2.47	2.48	2.28	2.44	2.45	2.54
1966/67	2.71	2.75	2.82	2.81	2.64	2.65	2.79	2.75
1967/68	2.47	2.50	2.50	2.50	2.37	2.43	2.45	2.49
1968/69	2.39	2.42	2.45	2.45	2.31	2.35	2.42	2.43
1969/70	2.35	2.34	2.38	2.39	2.18	2.25	2.34	2.35
1970/71	2.79	2.85	2.89	2.89	2.64	2.74	2.86	2.85
1971/72	3.06	3.04	2.91	3.02	2.89	2.97	2.93	3.03
1972/73	4.54	4.41	3.98	4.07	4.18	4.27	4.07	4.37
1973/74	5.64	5.72	5.66	5.67	5.27	5.50	5.55	5.68
1974/75	6.31	6.63	6.96	7.01	6.55	6.28	6.80	6.64
1975/76	4.89	5.00	4.66	4.76	4.38	4.88	4.56	4.92
1976/77	7.05	6.89	6.68	6.44	6.28	6.74	6.95	6.81
1977/78	5.63	5.82	5.97	6.04	5.35	5.68	5.95	5.88
1978/79	6.60	6.71	6.70	6.63	6.33	6.54	6.69	6.66
1979/80	5.82	6.22	6.40	6.41	5.95	5.91	6.40	6.28
1980/81	7.32	7.57	7.74	7.68	7.52	7.22	7.84	7.57
1981/82	5.90	5.14	6.14	6.25	5.70	5.72	6.15	6.04
1982/83	5.63	5.70	5.50	5.70	5.30	5.51	5.65	5.69
1983/84	7.69	7.88	7.83	7.83	7.52	7.60	7.87	7.81
1984/85	5.60	5.78	6.05	6.00	5.55	5.57	5.97	5.78
1985/86	4.92	5.05	5.04	5.12	4.71	4.86	5.19	5.04

[1] Average of States within region.
[2] Year beginning September 1.
[3] Season average price received by farmers weighted by the estimated percentage of the crop sold each month.
Source: (*50*).

Soybean Pricing System

The pricing system incorporates three important characteristics of soybeans and soybean products in the market process (*27*, p. 54):

- Soybean meal and oil are joint products of the soybean crushing industry, yet there is very little year-to-year change in the quantity of meal and oil produced from a bushel of beans.
- Soybeans, as well as the meal and oil components, have domestic use, export, and inventory demand components. Except for small quantities used for seed and feed, the domestic soybean use is for crushing.
- The prices of soybeans, meal, and oil and the allocation of available supplies among market alternatives are simultaneously determined due to the joint-product relationship.

The pricing system for soybeans is complex because it involves interactions between the markets for soybeans, soybean oil, and soybean meal (*1, 41, 42*). The intersection of total soybean demand and total soybean supply determines the price of soybeans. The total supply of soybeans is simply the current year's production plus carryin stocks from earlier years. But, underlying total soybean demand are demands for crushing (to produce oil and meal), exports, and stocks of soybeans. Underlying the demand for crushing are the demands for soybean oil and meal. There are domestic use, export, and stock demands for both soybean oil and soybean meal. The domestic use demand for soybean oil is affected by the prices of competing vegetable oils and animal fats. The domestic demand for soybean meal depends upon the livestock feed demand and the prices of competing protein meals. Prices of soybean oil and meal are linked in the crush sector, where the supplies of soybean oil and soybean meal are determined by the quantity of soybeans crushed. Higher soybean oil and meal prices increase the total demand for soybeans, but these higher prices simultaneously reduce the market demands for oil and meal.

Table 26—Annual market/farm price relationships for soybeans

Year [1]	Average cash market price [2]	Season average farm price	Price support loan rate	Market/farm price spread
	Dollars per bushel			
1965/66	2.91	2.54	2.25	0.37
1966/67	2.86	2.75	2.50	.11
1967/68	2.61	2.49	2.50	.12
1968/69	2.55	2.43	2.50	.12
1969/70	2.53	2.35	2.25	.18
1970/71	3.00	2.85	2.25	.15
1971/72	3.24	3.03	2.25	.21
1972/73	6.22	4.37	2.25	1.85
1973/74	6.12	5.68	2.25	.44
1974/75	6.33	6.16	2.25	.17
1975/76	5.26	5.06	[3]	.20
1976/77	7.33	7.11	2.50	.22
1977/78	6.14	5.88	3.50	.26
1978/79	7.11	6.66	4.50	.45
1979/80	6.51	6.28	4.50	.23
1980/81	7.67	7.57	5.02	.10
1981/82	6.26	6.04	5.02	.22
1982/83	6.12	5.65	5.02	.47
1983/84	7.86	7.81	5.02	.05
1984/85	5.98	5.78	5.02	.20
1985/86	5.30	5.04	5.02	.26

[1] Year beginning September for soybeans and October for price support loan.
[2] No. 1 Yellow soybeans, Illinois processor.
[3] Price support loans were not authorized in 1975.
Source: (*55*).

Relationships to Other Pricing Systems

The pricing system for soybeans is closely linked to pricing systems for other oil crops and animal fats through the close substitutability of soybean oil with other fats and oils and soybean meal with other protein meals. Other factors which affect the price of soybeans are macroeconomic factors such as interest rates, exchange rates, and Government programs for other commodities.

The Market for Fats and Oils. The vegetable oil and animal fats market is large and complex. Soybean oil is the dominant oil in this market but it competes with many other vegetable oils and animal fats (*16, 20, 23, 36, 39, 40, 69, 73*). The soybean oil link to the pricing systems of other vegetable oils comes mainly through the demand for bulk refined edible oil (*10, 11*). A minor amount of soybean oil is used for industrial processes or products, but this demand is largely independent of other oils. Another demand for soybean oil might be classified as refined oil demand for specific uses. Manufacturers use ingredient and price formulas to produce end products such as baking and frying fats, cooking and salad oils, and margarine and other spreads. These formulas often call for certain amounts of several different refined oils in fairly fixed portions, reflecting complementarity among the oils for these specific demands within a given product (*66*). Once the specific formula demands have been fulfilled for a product, the rest of the refined edible oil demand can be met by any minimum quality refined oil. This demand can be classified as the bulk or price-sensitive market for refined oil. Oils entering this

highly competitive market are substitutes for each other. Thus, the demand for soybean oil use in the domestic market can be broken into bulk markets, markets for specific industrial uses, and markets for specific refined uses.

Analysis of the relationship among various vegetable oils found that prices for soybean oil, cottonseed oil, and, to a lesser extent, peanut oil, were highly related to one another. Soybean oil and cottonseed oil are abundant enough in the United States to satisfy their specific demands and still leave adequate quantities to compete in the bulk market. Coconut oil, palm oil, and rapeseed oil prices were only slightly related to the rest of the oils (*11*).

Fryar analyzed the relationship of the U.S. and European vegetable oil markets (*10*). Using three different measures of integration between the markets—average prices, correlation and coherency squared, and elasticity of price transmission—he found that the U.S. and European markets for soybean oil, cottonseed oil, peanut oil, and coconut oil appear to be highly integrated, especially for annual or longer intervals. He found that the U.S. and European markets for palm oil and coconut oil were only moderately integrated.

The Market for Protein Meal. A similar approach also illustrates the interrelationship of the soybean meal pricing system with other meal pricing systems (*67*). Soybean meal is used mainly as high-protein livestock feed, with only minor amounts currently being used as protein products for human consumption. Feed rations usually include a certain amount of soybean meal because of the favorable amino acid content. Once this specific demand is met, the rest of the soybean meal competes in the bulk market as a protein source. Wendland and Hoskin found that, in the short run (less than 3 months), livestock producers do very little substitution between soybean meal and cottonseed, fish, and sunflowerseed meals (*67*). When price changes last longer than 3 months, users of meal become more sensitive to the prices of soybean, cottonseed, fish, and meat meal.

Response to Macroeconomic Factors. Soybean prices are affected by a variety of external factors including exchange rates, interest rates, and Government programs for competing crops. Exchange rates affect the local price paid by importing countries (*5, 13, 70*). If the value of the dollar increases in relation to a local currency, the relative price of U.S. soybeans rises proportionately. Recent estimates suggest that a 10-percent devaluation in the value of the dollar could cause U.S. soybean exports to rise as much as 7.8 percent (*5*).

Interest rates affect production and storage decisions. A rise in interest rates increases the cost of borrowing capital, hence raising production costs. Lowry and others have demonstrated how an increase in interest rates can affect the intraseasonal storage pattern of soybeans (*37*). A rise in interest rates will cause more soybeans to be marketed early in the year, thus lowering prices early in the season and raising them at the end.

Soybeans compete for acreage with other crops including corn and cotton (*8, 12, 14, 35, 68*). Changes in Government programs for these crops can cause farmers to shift their acreage from soybeans to corn or cotton (or vice versa). Lee and Helmberger have shown how soybean producers in the Corn Belt are affected as much by the price support and deficiency payment programs for corn as they are by soybean prices (*35*).

Value of Soybean Products

The value of soybeans depends on their oil and meal content and the price of these two products. The oil and protein contents of soybeans are inversely related. Soybeans having a higher percentage of oil will generally have a lower percentage of protein and vice versa. In the United States, the oil content tends to increase while the protein content tends to decrease as soybeans are grown in progressively warmer climates (*29, 44*). The oil and meal content of soybeans varies not only from region to region, but also from State to State and even from farm to farm because of differences in both geography and cultivation practices.

The amount of meal obtained from processing a bushel of soybeans greatly exceeds the amount of oil. Since 1975, meal yields have averaged more than 3.4 times that of oil. During 1985/86, for example, national oil yields averaged 11.01 pounds per bushel of soybeans compared with 47.27 pounds of meal. However, during the same period, soybean oil averaged 18.7 cents a pound compared with only 7.6 cents a pound for soybean meal (table 27). Oil usually sells at a higher price per pound than meal. Since 1975, soybean oil has accounted for, on average, 38.2 percent of the total product value obtained from a bushel of soybeans, and soybean meal has accounted for 61.8 percent of the value. For most other oilseeds, the meal represents a much smaller percentage of the total value for two reasons: first, most oilseeds contain a higher percentage of oil than the 18 percent in soybeans and, second, soybean meal commands a higher price than other oilseed meals because of its higher protein content (44 percent) and higher quality of protein.

Oil yield per bushel of soybeans grew from 8.5 pounds in 1932 to 9.5 pounds in 1947 and 11.0 pounds in 1953, where it has remained. This upward trend resulted primarily from changing processing techniques from hydraulic presses to screw presses and then to using a solvent to extract the oil. The increase was also partly due to the development and cultivation of soybeans containing greater quantities of oil.

Despite this trend of obtaining more oil from soybeans crushed, which means a lower yield of meal per bushel, the value of the meal has increased more than the oil. During 1940–49, soybean oil and soybean meal each contributed about 50 percent of the value of soybeans. By 1969, the values of soybean oil and meal were about 40 and 60 percent, respectively, and they remained near these levels through the 1970's. During the early 1980's, the value of oil declined to about one-third and meal increased to two-thirds. This change in the value of soybean products was caused by the greatly increased production of oils (particularly palm oil) in the edible oils market and the large displacement of fats and oils for industrial uses by petroleum-based synthetics. Other factors included increased demand and higher prices for protein meals to feed the increased number of livestock more nutritionally balanced diets. The value of oil rose to over 50 percent in 1984/85, but then decreased. A world surplus of edible oils and a strong demand for soybean meal during the 1986/87 marketing year caused the value of soybean meal to rise to 70 percent of the total value.

Processing Margins

The difference between the value of soybean products and the price of soybeans is called the processing margin. Spot (cash) processing margins fluctuate widely. A number of factors influence these margins. The buying practices of the processor depend partly on the processor's buying area. Also, the price the processor pays for soybeans varies considerably according to location, size of the mill, and the extent of

Table 27—Annual value of products per bushel of soybeans processed and spot price spread

Year [1]	Value of products per bushel						Total value	Share of total value		Price [4] No. 1 Yellow	Spread between value of products and soybean price
	Soybean oil			Soybean meal				Soybean oil	Soybean meal		
	Yield [2]	Price [3]	Value	Yield [2]	Price [3]	Value					
	Pounds	*Cents*	*Dollars*	*Pounds*	*Cents*	*Dollars*		*Percent*		*Dollars*	
1965/66	10.69	11.8	1.26	47.53	4.02	1.91	3.17	40	60	2.91	0.26
1966/67	10.70	10.4	1.11	47.66	3.98	1.90	3.01	37	63	2.86	.15
1967/68	10.57	8.6	.91	47.71	3.82	1.82	2.73	33	67	2.61	.12
1968/69	10.61	8.2	.87	47.43	3.76	1.67	2.66	33	67	2.55	.11
1969/70	10.66	11.0	1.17	47.36	3.89	1.84	3.01	39	61	2.53	.48
1970/71	10.83	12.8	1.38	47.39	3.96	1.88	3.26	43	58	3.00	.26
1971/72	10.98	11.5	1.26	47.43	4.36	2.07	3.33	38	62	3.24	.09
1972/73	10.59	15.2	1.62	47.04	11.03	5.19	6.81	24	76	6.22	.59
1973/74	10.76	30.2	3.25	47.18	7.61	3.59	6.84	48	52	6.12	.72
1974/75	10.51	32.1	3.37	47.48	6.56	3.12	6.49	52	48	6.33	.16
1975/76	10.94	18.5	2.02	47.27	7.20	3.40	5.42	37	63	5.26	.16
1976/77	11.09	24.1	2.67	47.81	10.14	4.85	7.52	36	64	7.33	.19
1977/78	10.88	23.8	2.59	47.33	8.13	3.85	6.44	40	60	6.14	.30
1978/79	11.06	27.0	2.99	47.51	9.40	4.47	7.46	40	60	7.11	.35
1979/80	10.74	24.6	2.64	48.01	8.90	4.27	6.91	38	62	6.51	.40
1980/81	11.09	23.3	2.58	47.93	11.09	5.32	7.90	33	67	7.67	.23
1981/82	10.72	19.1	2.04	47.86	9.25	4.43	6.47	32	68	6.26	.21
1982/83	10.76	19.2	2.07	47.88	9.06	4.33	6.40	32	68	6.12	.28
1983/84	11.26	31.1	3.50	47.36	9.78	4.63	8.13	43	57	7.86	.27
1984/85	11.05	30.0	3.31	47.15	6.33	2.99	6.30	53	47	5.98	.32
1985/86	11.01	18.7	2.06	47.27	7.60	3.59	5.65	36	64	5.30	.35

[1] Year beginning September 1.

[2] Actual production of oil and meal as calculated from Bureau of the Census reports.

[3] Simple average of monthly cash prices per pound using the following quotations: soybean oil, crude, tank cars, f.o.b. Decatur, IL; soybean meal, bulk, 44-percent protein, Decatur, IL.

[4] Simple average of monthly prices, Illinois processors.

Source: (55).

competition for soybean purchases. Another factor which varies widely among mills is product yields from a bushel of soybeans. The total net value of products from a bushel of soybeans depends not only on product yields but also on transportation costs to the markets and the sales price of soybean products which reflects conditions at the time of sale (*4*).

The annual average processing margin (based on spot prices) varied between 9 cents per bushel in 1971/72 and 72 cents in 1973/74 (table 27). The average margin for the decade was 32 cents per bushel, double the average for the decade of the 1960's. Low processing margins generally reflect excess crushing capacity. In the mid-1980's, a processing margin of less than 15 cents per bushel has been considered unprofitable.

Soybean processors attempt to "lock in," through use of the futures market, as much crush as possible when processing margins are favorable and as little as possible when margins are unfavorable. When the demand for soybean oil and meal is greater than production and the supply of soybeans is ample, soybean products sell high in relation to the cost of soybeans. This relationship means good processing margins and gives the processor a strong incentive to crush. Conversely, if the demand for soybean oil or soybean meal or both is weak or if soybeans are in short supply, the processing margins will probably be poor, reducing the incentive to crush. The seasonal pattern of soybean prices favors crush at the beginning of the crop year when soybean prices are low and the demand for millfeeds is high (due to colder weather, lack of grazing, and increased animal feed requirements). As the crop year progresses, the incentive to crush declines because of rising soybean prices and the weakening of the demand for millfeeds (*6*).

Futures and Options Markets

The price of soybeans fluctuates widely during a production season. This price variability places producers in a risky and uncertain position with respect to expected income. If prices drop significantly before the crop can be sold, the producer may face substantial financial losses.

Futures, options, and cash forward contracts enable farmers to reduce the risk that the price they receive for their crop might not cover the cost of their inputs. A futures contract specifies a standard grade of the commodity which must be delivered in fulfillment of the contract at some future date. In an option contract, the seller grants the buyer the right, for a limited period of time, to buy or sell a futures contract at a set price. The buyer pays a premium for this right but incurs no obligation. Both futures and options contracts can be canceled any time before they mature through offsetting trades on the exchange. Forward commitments executed outside of organized commodity exchanges are called cash forward contracts and often are based on an underlying futures or option contract (*45*).

The primary U.S. market for trading soybean futures and options contracts is the Chicago Board of Trade (CBT). Soybean futures have been traded continuously on the CBT since 1947. Futures trading in soybean oil began in 1950 with soybean meal added in 1951 (*10*). Options trading for soybean futures began in late 1984. The Commodity Futures Trading Commission approved trading of options for soybean oil and meal futures in 1986. Soybean futures and options contracts are also traded at the MidAmerica Commodity Exchange (MCE). Although more than 95 percent of the average daily volume is traded at the CBT, the MCE offers small lot contracts (1,000 bushels) to traders who may not produce enough to fulfill the terms of a 5,000-bushel contract at the CBT. The delivery months for futures and options contracts for soybeans are January, March, May, July, August, September, and November. Delivery months for soybean oil and meal are January, March, May, July, August, September, October, and December.

Marketing Strategies

Sharp fluctuations in soybean prices during the last decade have heightened producer interest in alternative methods and strategies that may be used to establish the price of their production. This section summarizes the methods used by producers to establish the price in 21 major soybean-producing States. The data are from surveys of soybean producers in the spring of 1983 and 1984 (*54*, 1984). The marketing season for each crop year provides some unique pricing opportunities depending upon expectations concerning supply and demand conditions for a particular crop. Therefore, caution must be exercised in comparing survey data from Southern States (1982 crop) with those from Midwestern States (1983 crop) and in comparing these survey findings with current marketing opportunities (table 28).

Marketing Methods

Producers participating in the surveys were asked about the disposition of the crop harvested the previous fall. First, they were asked how many bushels they sold directly from the field to a buyer who provided transportation. Second, they were asked how many bushels they delivered to off-farm destinations

(such as elevators or processors) at harvest and what disposition was made of those deliveries. Third, they were asked how many bushels were stored onfarm following harvest and what proportion of that total had been sold before the survey was conducted in the spring.

Pricing Arrangements

Producers who indicated that soybeans had been sold directly from the field, sold at time of delivery to an off-farm destination, or sold from onfarm storage facilities were asked to identify the pricing arrangement used to establish the price received. Producers specified the percentage of each type of sale they priced through (1) cash forward, (2) cash market offers, and (3) deferred pricing contracts.

The cash forward contract arranges the quantity to be delivered and the price that will be received in advance of the delivery date. These contracts may specify delivery from the field at harvest or from farm storage at a later date. The cash market offer is the traditional arrangement where the producer accepts the buyer's offer or bid price on the date the soybeans are delivered and title is transferred to the buyer. Under a deferred pricing contract, the producer delivers the soybeans and transfers title to the buyer but defers the establishment of a price until a later date.

Table 28—Proportion of soybean crop sold directly from the field and pricing arrangement used [1]

Region and State	Proportion of crop sold infield	Pricing arrangement		
		Cash forward contract	Cash bid	Deferred pricing
		Percent		
Midwestern States:				
Illinois	1.3	8.0	92.0	—
Indiana	2.2	14.8	85.2	—
Iowa	1.3	47.5	42.1	10.4
Kansas	1.4	—	100.0	—
Michigan	2.7	100.0	—	—
Minnesota	2.0	92.1	—	7.9
Missouri	0	—	—	—
Nebraska	3.2	24.5	75.5	—
Ohio	0	—	—	—
South Dakota	.2	100.0	—	—
Wisconsin	6.8	69.6	30.4	—
11 States	1.5	38.7	58.3	3.0
Southern States:				
Alabama	6.1	—	100.0	—
Arkansas	4.2	17.2	56.7	26.1
Georgia	18.9	12.8	81.5	5.7
Kentucky	0	—	—	—
Louisiana	10.8	25.9	71.1	—
Mississippi	8.0	14.5	85.3	.2
North Carolina	14.0	—	100.0	—
South Carolina	10.7	—	100.0	—
Tennessee	5.2	33.0	33.0	34.0
Virginia	3.4	50.0	50.0	—
10 States	8.4	14.2	80.1	5.7
21 States	3.4	22.1	73.1	4.8

— = Not used.

[1] Producers in the Midwestern States and Kentucky were contacted during the spring of 1984 concerning the marketing of the 1983 crop. Producers in other Southern States were contacted during the spring of 1983 concerning the marketing of their 1982 crop.

Deferred pricing contracts are generally accomplished through one of two ways (*17*). A deferred pricing contract specifies the price received will be the cash market price offered by the buyer, less a specified service charge, on the day the producer chooses to price the soybeans. The buyer receives title to the soybeans on the day the contract is drawn. A second method involves a "basis" contract where the price will be the price of a specified futures contract at the time chosen by the seller, minus the basis that exists at the time the contract is drawn. A basis is the difference between the price for a futures contract and the price for the same or similar commodity for spot delivery at a particular location (*46*). Again, the buyer receives title to the soybeans when the contract is drawn. The seller usually receives about 80 percent of the cash price at the time of delivery, with final settlement at the time the seller elects to price the soybeans.

Pricing Soybeans Sold Directly from the Field

When soybeans are sold directly from the field, the buyer sends a truck to the field and takes title to the soybeans when they are transferred from the combine. The proportion handled by this arrangement ranged from zero in Kentucky, Missouri, and Ohio to a high of 19 percent in Georgia (table 28). Selling directly from the field was more common in the Southern States.

The cash market offer was the most popular pricing arrangement in 11 States and was more common in the Southern States. Cash forward contracts were the predominant pricing arrangement in five States and were generally more common in Midwestern States. Deferred pricing contracts were used to price more than 25 percent of the soybeans sold directly from the field in Arkansas and Tennessee. Producers in only six States used deferred pricing contracts to establish the price for soybeans sold directly from the field.

Pricing Soybeans Delivered Off-Farm at Harvest

Delivery to off-farm destinations was the predominant handling method in all Southern States, and Arkan-

sas producers delivered over 90 percent of production at harvest (table 29). In contrast, producers in 5 of the 11 Midwestern States delivered less than 50 percent of their 1983 production to off-farm destinations at harvest.

Producers who delivered soybeans off farm at harvest were asked what proportion was sold at time of delivery (table 29). Producers in Southern States generally sold a larger proportion of harvesttime deliveries than did their counterparts in the Midwest. Producers in Iowa, Kansas, and Nebraska sold at delivery less than half of the soybeans delivered to off-farm destinations. Producers who sold soybeans at delivery also provided information on how those sales were priced (table 29). These data show substantial variation among States in the extent to which different pricing arrangements were used. The cash market bid was the predominant pricing arrangement in all States except Illinois, Michigan, and Minnesota, and producers in those three States priced about half of the harvesttime sales using cash forward contracts. In contrast to producers in other Midwestern States, Kansas producers priced a significantly smaller proportion of harvesttime sales with cash forward contracts. Furthermore, Kansas was the only State where deferred pricing contracts were not used to price harvesttime sales.

Producers in North Carolina and South Carolina did not use cash forward contracts to price soybeans in 1982/83. The greater reliance on cash market bids to establish prices in the Southern States may reflect greater involvement of cooperatives in the marketing of soybeans in several of those States. Kentucky and Tennessee were the only Southern States where cash forward contracting accounted for more than 20 percent of the volume sold at time of delivery at harvesttime.

Table 29—Proportion of soybean crop delivered off-farm at harvest, proportion sold at time of delivery, and pricing arrangement used [1]

Region and State	Proportion of crop delivered off farm	Proportion sold at time of delivery	Pricing arrangement		
			Cash forward contract	Cash bid	Deferred pricing
	Percent				
Midwestern States:					
Illinois	44.5	55.8	51.4	46.7	1.9
Indiana	38.1	79.6	38.8	58.7	2.5
Iowa	48.6	42.9	41.7	55.0	3.3
Kansas	69.8	43.4	11.2	88.8	—
Michigan	82.6	62.6	48.6	47.0	4.4
Minnesota	39.2	54.3	52.3	38.1	9.6
Missouri	52.8	69.9	24.4	72.5	3.1
Nebraska	57.1	45.3	35.3	54.5	10.2
Ohio	59.3	59.9	43.9	48.6	7.5
South Dakota	66.1	83.0	31.3	67.6	1.1
Wisconsin	40.2	64.1	30.5	61.4	8.1
11 States	48.8	56.9	40.9	55.5	4.1
Southern States:					
Alabama	67.9	88.1	3.6	94.7	1.7
Arkansas	90.6	55.5	5.6	91.8	2.7
Georgia	53.5	78.0	10.8	84.1	5.1
Kentucky	53.9	81.5	32.1	62.1	5.8
Louisiana	58.5	64.5	7.8	78.3	13.9
Mississippi	69.8	64.4	14.2	74.0	11.8
North Carolina	60.0	79.7	—	99.4	.6
South Carolina	54.5	65.6	—	93.5	6.5
Tennessee	63.1	89.2	23.7	75.3	1.0
Virginia	72.3	69.2	2.8	92.5	4.7
10 States	66.4	70.7	10.5	84.0	5.5
21 States	53.6	61.3	29.2	66.1	4.7

— = Not used.

[1] Producers in the Midwestern States and Kentucky were contacted during the spring of 1984 concerning the marketing of the 1983 crop. Producers in other Southern States were contacted during the spring of 1983 concerning the marketing of their 1982 crop.

Pricing Soybeans Sold from Onfarm Storage

At the time the surveys were conducted in the spring of 1983 and 1984, the pricing and marketing of the crop harvested the preceding fall were incomplete. The surveys were conducted around April 1 each year, so about 5 months of the marketing season remained (April–August).

The extent to which producers in various States use onfarm storage in their marketing plan is influenced by the number of farms that have storage facilities suitable for storing soybeans, and the prospects for price gains as the upcoming marketing season progresses. The share of production stored onfarm ranged from a low of about 5 percent in Arkansas to a high of almost 61 percent in Minnesota (table 30). Except in Michigan, many soybean producers in the Midwest owned onfarm storage facilities. Those producers relied more heavily on farm storage as a marketing and pricing strategy and generally stored a larger share of production at harvesttime.

The amount of farm-stored soybeans that had been sold before the springtime surveys varied greatly by State, ranging from 14 percent in Tennessee to 72 percent in Louisiana. Less than 50 percent of the quantity stored had been sold in 15 of the 21 States where surveys were conducted.

The strategy used to price soybeans sold from onfarm storage also varied greatly (table 30). Producers in all Midwestern States, except Kansas, used cash forward contracting extensively in pricing farm-stored soybeans; it was the predominant pricing arrangement in 6 of the 11 Midwestern States. In contrast,

cash forward contracts were not used at all in four Southern States.

Deferred pricing contracts were more common in the case of sales from farm storage. This result was surprising in view of the fact that deferred pricing contracts are often used by producers who do not have space to store the soybeans but wish to defer the pricing decision. Almost half of the sales from farm storage in Louisiana were sold under deferred pricing contracts. Those contracts were also important pricing strategies in Ohio and North Carolina, accounting for over a fifth of the sales from farm storage in each State. As was true of sales at harvesttime, the cash-market offer was the predominant pricing arrangement in most of the States.

Pricing Methods

Pricing opportunities vary seasonally and yearly. The pricing period for a particular crop year is about 18 months in length: beginning in February preceding the planting period and ending about July of the year following harvest. Producers must formulate their marketing plans early and revise them frequently as factors which affect pricing prospects change. Producers may make two major errors in establishing price. One is accepting a price that is too low to ensure the survival of the farm business. The other is passing up a good pricing opportunity in hopes of getting a better price which never comes.

Table 30—Proportion of soybean crop stored onfarm, production sold before spring, and pricing arrangement used [1]

Region and State	Proportion of crop stored onfarm	Proportion sold before spring	Pricing arrangement		
			Cash forward contract	Cash bid	Deferred pricing
	Percent				
Midwestern States:					
Illinois	54.5	43.2	49.6	39.7	10.7
Indiana	59.7	59.2	44.0	47.3	8.7
Iowa	50.1	40.8	47.1	40.6	12.3
Kansas	29.0	22.5	—	96.7	3.3
Michigan	14.7	29.3	54.5	32.7	12.8
Minnesota	60.8	46.7	52.0	36.9	11.1
Missouri	45.2	63.9	42.2	49.0	8.8
Nebraska	39.7	47.2	37.2	50.6	12.2
Ohio	40.7	51.3	51.8	27.0	21.2
South Dakota	33.7	28.8	50.0	50.0	—
Wisconsin	53.0	43.3	63.7	36.3	—
11 States	49.8	47.3	47.0	41.8	11.2
Southern States:					
Alabama	26.0	27.7	43.4	42.6	14.0
Arkansas	5.2	14.6	38.1	55.7	6.2
Georgia	27.6	37.8	24.5	69.5	6.0
Kentucky	46.1	63.6	20.9	67.2	11.9
Louisiana	30.7	72.1	42.3	10.4	47.3
Mississippi	22.2	55.6	22.1	66.7	11.2
North Carolina	26.0	28.3	—	78.1	21.9
South Carolina	34.8	27.7	—	100.0	—
Tennessee	31.7	13.8	—	100.0	—
Virginia	24.3	40.3	—	100.0	—
10 States	25.2	43.7	25.5	54.2	20.3
21 States	43.0	46.8	43.9	43.6	12.5

— = Not used.

[1] Producers in the Midwestern States and Kentucky were contacted during the spring of 1984 concerning the marketing of the 1983 crop. Producers in other Southern States were contacted during the spring of 1983 concerning the marketing of their 1982 crop.

The first decision that must be made in the pricing period is to evaluate cash forward opportunities that exist. These opportunities must be evaluated in relation to the minimum price needed to cover production costs and anticipated harvesttime cash prices based on expected supply and demand conditions. At harvest, producers must decide whether to accept the cash price or hold their soybeans. If they decide to hold the soybeans, they must choose the most appropriate method of retaining ownership.

Cost of Ownership. Selecting the method of retaining ownership is a difficult decision because the variables that determine ownership cost change yearly. Five alternative methods of retaining ownership will be evaluated in this section: onfarm storage, commercial storage, sell cash-buy futures, basis contract, and deferred pricing (DP) contracts.

The cost of onfarm storage depends upon the individual producer's situation. If storage facilities already exist, overhead costs will be incurred whether or not the facilities are used, and those costs are not necessarily included in the calculation of ownership costs. The costs of owning soybeans in farm storage include foregone interest, storage expenses, and extra handling expenses. The producer also assumes the risk of quality deterioration.

Holding in commercial storage is an option open to all producers. Ownership costs include the interest on the value of the soybeans plus the storage charges at the commercial warehouse. The warehouser assumes the responsibility for quality maintenance under this arrangement.

Selling soybeans in the cash market and replacing this sale by purchasing a futures contract is a third method of retaining ownership. The costs associated with a futures transaction include maintaining a margin account and commission fees. An indirect cost item that must be included in this arrangement is any improvement in the basis because any improvement in the local cash price in relation to that futures contract is an opportunity cost to the producer. The extent to which the basis improves is a gain the pro-

ducer would have realized by retaining ownership of the actual soybeans.

The ownership cost associated with a basis contract is similar to retaining ownership by buying futures. The major cost item is the basis improvement after the contract is made. Interest cost on the portion of the cash value not covered by the advanced payment and any service charges assessed by the buyer for this pricing alternative must be included in the analysis. This charge is generally assessed by fixing the basis in the contract at a few cents a bushel less than the current basis.

The ownership cost of a deferred pricing contract includes interest on the value of the soybeans at time of delivery plus the service charge assessed by the buyer. In this case, the buyer will earn interest on the value of the soybeans but will lose the basis improvement. Consequently, a positive service charge will be assessed when the potential basis improvement exceeds the interest earned.

Estimating the potential basis improvement is the most difficult part of the decision process. Producers must have a good knowledge of past basis patterns if they are to make informed decisions regarding the relative merits of deferred pricing arrangements and ownership through futures transactions. Retaining ownership of soybeans beyond harvest is a speculative decision. Price gains in the cash market or futures market will not necessarily exceed ownership cost. However, once the decision is made to retain ownership following harvest, the producer should develop sound estimates of the relative cost of ownership for each alternative and choose the least expensive method.

Government Programs for Soybeans

Before World War II, the United States imported about 40 percent of its fats and oils, largely from Indonesia, China, and the Philippines. The increasing need for larger supplies of agricultural commodities, including soybeans, to satisfy wartime demands led to a shift from programs restricting production to programs emphasizing production expansion. In July 1941, existing legislation was amended to increase the loan rates for basic commodities and to provide price supports at not less than 85 percent of parity for the nonbasic commodities (including soybeans for oil) if designated by the Secretary of Agriculture for increased production (*56*).

The first price support program for soybeans was authorized for the 1941 crop. The national average loan rate for the 1941 crop of soybeans was set at $1.05 per bushel. Price supports have been available every year since 1941 except 1975. Loans were not authorized for soybeans in 1975 because of the relatively high price and expectations for continued strong demand (*56*).

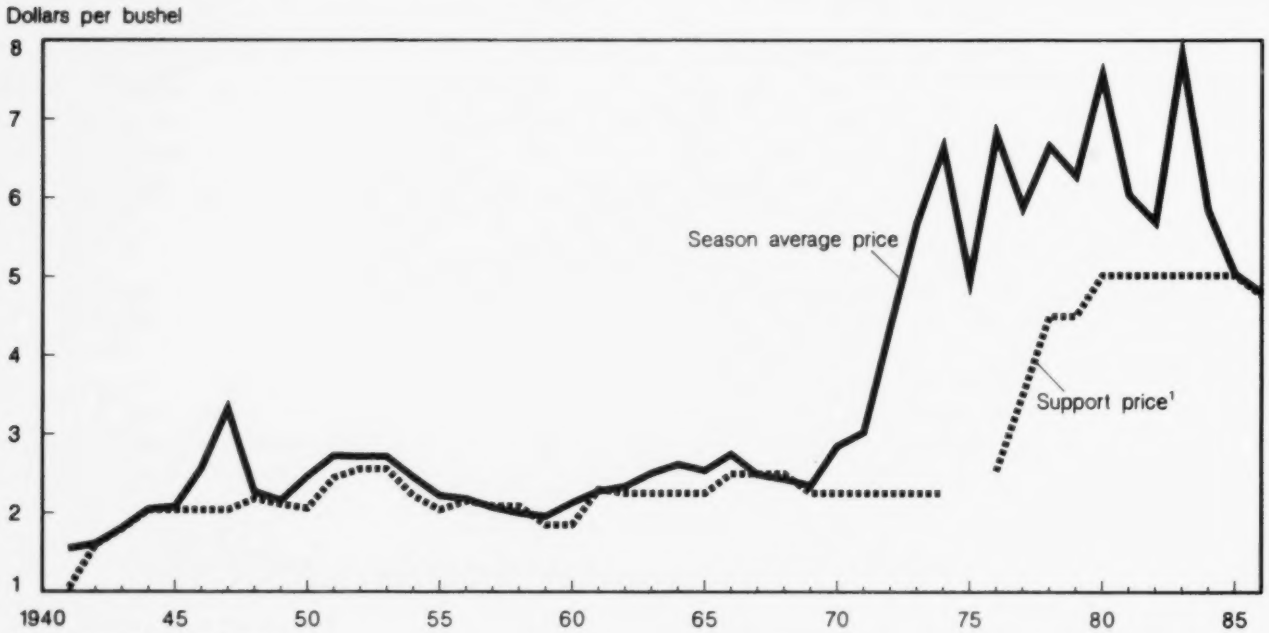
Price supports were made available to participants in the program through nonrecourse loans by the Commodity Credit Corporation (CCC). Farm storage loans were made on a note and chattel mortgage basis. Warehouse loans were available on a note and loan agreement basis with warehouse receipts serving as collateral.

The season average price of soybeans has exceeded the price support level for most years since 1941 (fig. 4). Nevertheless, substantial quantities of soybeans were often placed under price supports, particularly during years when high production led to relatively low prices. For example, the production in 1954 led to lower prices, and farmers reacted to the price decline by placing 41.4 million bushels of soybeans under price supports.

Production was even larger in 1958 when the quantity of soybeans under price supports increased to 140.1 million bushels. Faced with the possibility of having to acquire large quantities of soybeans under price support loans, CCC offered, for the first time, a reseal program for farm-stored soybeans from the 1958 crop. Under this program, farms in designated areas could extend their farm storage loans or convert their purchase agreements to loans for an additional year following the loan maturity date. Large amounts of soybeans have often been placed under price supports, but CCC acquisitions of soybeans have been relatively small in most years (table 31).

Acreage allotments or marketing quotas have not been used to restrict soybean production. However, programs for feed grains, cotton, and wheat often included provisions for the substitution of soybeans for one or more of these crops on their allotted acreages. These programs sometimes restricted the acreage a farmer could plant to soybeans. In 1961, for example, soybeans eligible for price supports were restricted to farms where the 1959–60 average acreage of conserving and idle land had been maintained. This requirement was included to ensure that increases in soybean production came from acreages used for crops in abundant supply (wheat, cotton, and corn) rather than idle and conserving use land. Although the cross-compliance provisions of these programs may have affected the acreage planted to soybeans, adjustments in soybean production have been attempted largely through changes in price support loan rates and program provisions for competing

Figure 4
Soybean support price and season average price



1/ No price support program in 1975

commodities. For example, the 1966 feed grain program was revised to encourage increased soybean production to meet national and international demand. This change provided price support payments to voluntary participants in the feed grain program who planted soybeans on feed grain acreages. Other incentives that year included increases in soybean price supports from $2.25 to $2.50 per bushel and extension of the feed grain signup period in soybean producing areas.

The Agricultural Act of 1970 gave farmers greater freedom to make shifts between soybeans and alternative crops (corn or feed grains in the Midwest, cotton in the South) by providing farmers the option of planting soybeans on the allotted acreages of basic crops to maintain their allotment history. This provision was first applied to the 1972 crop. The Agriculture and Consumer Protection Act of 1973 continued the Secretary's discretionary authority to provide price supports for soybeans and to allow the substitution of soybeans for feed grains, wheat, or cotton on acreage allotments for these crops. The act also required the Secretary to maintain a disaster reserve totaling more than 75 million bushels of wheat, feed grains, and soybeans. The reserve was to be separated from market supplies and used only to alleviate distress caused by natural disaster. The sharp rise in soybean prices ($12.12 per bushel at Chicago in mid-June 1973) and short supply led to an export embargo on 1973-crop soybeans and soybean products.

Price supports were continued in 1974, but few farmers placed their soybeans in the support program because of continuing relatively high market prices. Because of the high prices at that time, price supports were not provided for the 1975 crop of soybeans, but the program was reinstated in 1976 with the loan rate set at $2.50 per bushel.

The Food and Agriculture Act of 1977 included a mandatory loan and purchase program for soybeans. Price support rates were based on domestic and international supply and demand in relation to competing commodities. Neither target prices nor cropland set-aside was authorized for soybeans under the 1977 Act.

The Agriculture and Food Act of 1981 continued price support loans for the 1982–85 soybean crops.

Although the 1977 Act left the loan rate to the discretion of the Secretary of Agriculture, the 1981 legislation required the Secretary to establish the rate for soybeans at 75 percent of the simple average price of soybeans received by farmers over the preceding 5 marketing years (excluding the high and low years) but not less than $5.02 per bushel. The act did not require reductions in soybean acreages as a condition of eligibility for price support loans.

Soybeans are usually grown as part of a crop mix on individual farms, especially with corn, wheat, and cotton. Thus, farmers growing soybeans must consider the effects on soybeans of other Government programs. Although soybeans were not covered in the 1983 payment-in-kind (PIK) program, soybean acreage declined because soybeans were not allowed to be planted on conservation use acres, such as those set aside in the wheat PIK program. This provision reduced the amount of double-cropped wheat and soybeans. The PIK program improved the market prospects for corn, wheat, rice, and cotton, and farmers shifted some soybean acreage to the allowed acreage of those crops.

Table 31—Price supports, season average prices, and quantities of production under price support program

Year [1]	Support price		Season average price	Put under support		Acquired by CCC under support program	Owned by CCC Aug. 31
	Per bushel	Percentage of parity		Quantity	Percentage of production		
	Dollars	*Percent*	*Dollars*	*1,000 bushels*	*Percent*	*1,000 bushels*	
1950	2.06	80	2.47	14,967	5.0	29	1
1951	2.45	90	2.73	11,133	3.9	57	1
1952	2.56	90	2.72	14,100	4.7	3,858	1,980
1953	2.56	90	2.72	31,790	11.8	7	13
1954	2.22	80	2.46	41,413	12.1	15,550	6,570
1955	2.04	70	2.22	30,133	8.1	2	17
1956	2.15	75	2.18	65,729	14.6	27,315	5,166
1957	2.09	70	2.07	90,552	18.7	44,509	13,882
1958	2.09	70	2.00	140,215	24.2	87,253	44,240
1959	1.85	64	1.96	52,386	9.8	3,844	9,665
1960	1.85	64	2.13	25,617	4.6	7	0
1961	2.30	80	2.28	132,465	19.5	60,506	42,517
1962	2.25	76	2.34	68,780	10.3	1,186	1,654
1963	2.25	75	2.51	72,835	10.4	12,191	3,039
1964	2.25	74	2.62	28,573	4.1	8	9
1965	2.25	74	2.54	86,573	10.2	29	9
1966	2.50	78	2.75	153,521	16.5	26,421	7,340
1967	2.50	76	2.49	201,371	20.6	84,361	29,435
1968	2.50	74	2.43	340,271	30.8	170,102	171,423
1969	2.25	62	2.35	179,499	15.9	232	150,191
1970	2.25	60	2.85	146,420	13.0	83	2,500
1971	2.25	56	3.03	168,204	14.3	111	1
1972	2.25	54	4.37	90,555	7.1	36	0
1973	2.25	45	5.68	124,177	8.0	52	0
1974	2.25	37	6.64	34,554	2.8	7	0
1975	[2]	0	4.92	0	0	0	0
1976	2.50	34	6.81	22,471	1.7	2	0
1977	3.50	46	5.88	97,548	5.5	104	0
1978	4.50	51	6.66	64,173	3.4	179	0
1979	4.50	45	6.28	122,084	5.4	275	1
1980	5.02	43	7.57	133,209	7.4	3,412	76
1981	5.02	40	6.04	221,486	11.1	23,319	512
1982	5.02	39	5.69	396,564	18.1	245	20,851
1983	5.02	39	7.81	100,210	6.1	410	700
1984	5.02	39	5.78	278,296	15.0	151,000	4,400
1985	5.02	40	5.04	515,000	24.5	291,000	131,300

[1] Year beginning September 1.
[2] Price supports were not authorized for the 1975 crop.
Source: (*50, 51*).

The Food Security Act of 1985 set the loan rate for 1986 and 1987 at $5.02 per bushel (*15*). For 1988–90, loan rates will be based on 75 percent of the average price received by producers in the preceding 5 marketing years disregarding the high and low years, with declines limited to 5 percent per year and a floor of $4.50 per bushel. In all 5 years, the Secretary has the authority to reduce the loan rate an additional 5 percent if necessary to make soybeans competitive in the world market while maintaining the $4.50 floor. The Secretary used this authority to set the loan rate for 1986 at $4.77 per bushel. Under provisions of the Balanced Budget and Emergency Deficit Control Act of 1985 (better known as Gramm-Rudman-Hollings), the effective loan rate was reduced to $4.56 per bushel. In addition, if soybeans remain uncompetitive in world markets, the Secretary may initiate a marketing loan program where a producer could repay the loan at the prevailing world market price, as determined by the Secretary. As in earlier acts, participation in acreage reduction programs is not required as a condition of eligibility for price supports for soybeans. Under the 1985 Act, the planting for harvest of soybeans on reduced acreage or acreage set aside or diverted from production under any other program is prohibited.

Soybean Processing

Soybean processing has expanded from a relatively small operation in the early 1920's to become the leading U.S. oilseed processing industry. The early pioneers of soybean processing used small-scale hydraulic or screw presses which were often associated with cottonseed operations (*9*). Marked improvements in processing methods and facilities since that time have increased processing efficiency and enhanced industry growth.

Development of Processing

Both mechanical and solvent methods can be used for extracting soybean oil. Most soybean processing plants used the hydraulic press method prior to 1920. As soybean crushing operations progressed in the United States, hydraulic presses quickly gave way in the late 1920's to the more efficient screw presses when separate soybean processing facilities were built. The screw press method reached its peak in 1939 when about 75 percent of the soybeans processed were crushed by this method (*31*). The Hildebrandt solvent extraction process was introduced in the United States in 1934 (*38*). In subsequent years, all the larger new plants used the solvent extraction process. By 1959, about 93 percent of the soybean crush was processed by the solvent extraction method (*47*). Analyses of the soybean oil extraction processes indicate that the larger the mill the greater the advantage of the solvent extraction method over the screw press operation. Because greater efficiency was required, the screw press soybean oil mills, when worn out or fully depreciated, were replaced with larger solvent extraction mills. There are indications that investment requirements per bushel decline more rapidly for the solvent process than for the screw process. Solvent mills are also more efficient in both oil yield and labor requirements. Virtually all soybean processing in the United States today uses the solvent extraction process (*30, 31, 71*).

A variant of the solvent extraction method of processing oilseeds is the prepress solvent extraction process. This process is a combination of the screw press and solvent methods. In this process, oilseeds are first put through the screw press extraction unit, and the resulting meal is subjected to the solvent extraction process. The prepress method of solvent extraction is used primarily on oilseeds containing over 20 percent oil such as sunflower seeds, safflower seeds, and flaxseeds. Oil mills of this type have more flexibility in the kinds of oilseeds processed. Some soybeans and some other oilseeds are also processed by this type oil mill.

Soybean Oil Mills

The number of soybean oil mill establishments rose from 102 in 1963 to 121 in 1977 and then declined to 114 in 1982 (table 32) (*63*). A dramatic concentration of companies occurred between 1977 and 1982 when the number of companies fell from 65 to 34. The largest numbers of establishments are in Iowa and Illinois, 29 percent of all such facilities in both 1977 and 1982.

Soybean oil mills specialize in the production of their primary products, soybean oil and meal; relatively little mill activity involves other products such as cooking oil, shortening, and animal feeds. The specialization ratio, which measures the value of shipments of primary products divided by the value of shipments of primary products plus secondary products, has remained high and fairly constant over the Census of Manufactures Surveys from 1963 to 1982. Virtually all soybean oil and meal is shipped from mills specializing in soybean processing. The coverage ratio measures the value of shipments of primary products made by this industry divided by the value of shipments of the primary products made in all industries. This ratio has ranged between 95 and 98 percent since 1963. Other industries that shipped soybean oil and meal were cottonseed mills, wet corn mills, and prepared feeds manufacturers, not elsewhere classified.

Table 32—Soybean oil mills

Year	Companies	Establishments	Employees		Value added	Value of shipments	Ratios	
			All	Production workers			Specialization	Coverage
	Number		*Thousands*		*Million dollars*		*Percent*	
1963	68	102	6.5	4.6	152.1	1,473.4	89	95
1967	60	102	8.0	5.5	215.4	2,148.3	86	96
1972	54	94	9.1	6.6	350.0	3,357.2	85	96
1977	65	121	9.4	6.6	373.8	7,580.0	87	98
1982	34	114	8.9	6.2	678.2	8,603.6	88	95

Source: (*63*).

Primary products accounted for 80 percent, secondary products 11 percent, and miscellaneous receipts 9 percent of the value of shipments by the soybean oil mills industry. The major secondary production shipped was shortening and cooking oils, followed by prepared feeds, not elsewhere classified. The bulk of the miscellaneous receipts were sales of products bought and resold without further manufacture, processing, or assembly at the establishment.

The size of the establishments was broken down by number of employees (table 33). The 1982 distribution of number of establishments is similar to the 1977 distribution with the largest number of establishments being in the 50–99 employee bracket. The distribution of the value of shipments also remained fairly constant between 1977 and 1982 with a slight percentage increase in the 250–499 employee bracket in 1982, compared with 1977, offsetting a similar decrease in the 100–249 employee bracket.

Table 33—Distribution of soybean oil mills by size

Number of employees	Establishments		Value added by manufacture		Value of shipments	
	1982	1977	1982	1977	1982	1977
	Number		*Million dollars*			
1–19	30	34	5.2	2.0	51.5	66.6
20–49	21	22	60.8	46.3	987.2	839.3
50–99	38	37	236.6	67.5	3,514.7	3,217.2
100–249	17	21	208.6	196.0	2,079.0	2,027.6
250–499	8	8	167.5	66.1[1]	1,970.8	1,429.0[1]
500–999	0	1	0	[2]	0	[2]

[1] Includes data for establishments with 500–999 employees.
[2] Withheld to avoid disclosing operations of individual companies.

Source: (*63*).

Processing Steps

During the soybean harvesting season, processors generally receive soybeans as fast as facilities will permit. Each lot of soybeans is tested for moisture and oil content upon its arrival at the processing plant. Lots are then segregated by putting all beans with higher moisture content and, thus, more susceptible to spoilage, in a separate bin. To prevent loss, soybeans with the highest moisture content (over 14 percent) are usually either processed immediately or dried to a safe storage level. They may be cleaned before drying, particularly if the beans contain a high level of foreign material. Soybean lots are blended (to make the plant flow as homogeneous as possible) and then stored until processing. Recleaning the beans before processing to remove foreign material remaining in the lot is a common practice.

In the actual processing, soybeans are first cracked (which breaks them into small pieces), conditioned with heat, and then put through the flaking rolls. Cracking rolls gradually reduce particle size and also remove the hulls, which are then suctioned off. Hulls are added back to the meal after processing. The hydraulic press consists of a series of rectangular steel boxes which are perforated on the bottom and placed one on top of another. A quantity of heat-conditioned soybean flakes is wrapped in press cloth and placed in each box. The oil is then pressed from the flakes by gradually increasing the vertical pressure. In the screw press method of oil extraction, the heat-conditioned soybean flakes are continuously under pressure created by a revolving screw inside a cylinder which presses out the oil. Both mechanical processes are carried out under elevated temperatures. Hydraulic presses and screw presses are both usually arranged in batteries in a plant to facilitate feeding the machines and removing the oil and meal.

In the solvent method of extraction, the heat-conditioned soybean flakes enter the extraction column and are mixed with solvent (almost always hexane) which separates the oil and carries it off. After the solvent is removed, the oil is stored in tanks. After the solvent is also removed from the remaining meal,

the meal is toasted and cooled. It is then screened, ground, and stored in bins.

Soybean meal must be heated sufficiently to inactivate the antinutritional factors but not enough to damage the protein. In solvent processing, the meal is not heated sufficiently to accomplish this change and must be toasted. Toasting screw press meal is not necessary because of the higher operating temperatures. However, care must be taken not to damage the protein.

The amount of soybean hulls returned to the meal depends on the protein guarantee of the meal. If hulls are not returned, 49-percent protein soybean meal is produced with a maximum of 3-percent fiber. Regular soybean meal, with the hulls returned, contains 44-percent protein and a maximum of 7-percent fiber. Futures contracts call for 44-percent protein soybean meal.

Soybean hulls, in addition to being returned to the meal, are marketed as soybean hull meal which contains not less than 11-percent protein and no more than 35-percent fiber. The hulls are also marketed in soybean mill feed which is a mixture of soybean hulls and mill tailings from the manufacture of soy flour or grits containing not less than 13-percent protein and not more than 32-percent fiber.

After processing soybeans into oil and meal, processors sell the oil to refiners, exporters, and manufacturers of consumer or industrial products. Soybean oil is primarily used in edible products, such as salad and cooking oils, margarine, shortening, and salad dressings. Some soybean oil is used in industrial products such as paints, plasticizers, and fatty acids. Processors sell the meal to feed manufacturers or to exporters. Feed manufacturers use the soybean meal as a high-protein ingredient in their prepared feeds for the livestock and pet food industries. They also sell soybean meal to farmers for use in feeding livestock.

Soybean Receipts and Holdings

Soybean processors usually receive the largest volume of beans during harvest when prices usually fall to a seasonal low. Receipts are highest during October. During the 1980–84 crop years, processing plants on average received over a third of the year's soybeans by the end of November, over half by the end of January, and over two-thirds by the end of March (*64*).

Based on average holdings for the 1980–84 crop years, the volume of soybeans at mills reaches its seasonal peak in November and then trends downward the rest of the marketing year.

Soybean Crushings

In contrast to the soybean receipt pattern of mills, soybean crushings are relatively stable throughout the year, with about 8 percent of the year's total crushed each month (*64*). Soybeans store well for an extended period of time, making this pattern possible. The stable crushing pattern reflects the relatively even year-round demand for soybean oil and meal products and the efficiency of operating solvent extraction plants at a steady output.

During the 1980–84 crop years, the soybean processing industry's average monthly crush ranged from a low of 7.3 percent to a high of 9.6 percent. Before the arrival of a new crop of soybeans, mills usually cease operations for repairs and maintenance. Therefore, July to September are the low months for crushings. The highest average monthly crushing is normally in December. However, the peak month varies from year to year. Usually slightly over a third of the annual crush occurs by the end of December, and slightly over two-thirds by the end of April. One can usually estimate total soybean crush quite accurately from these benchmarks because of the relatively small deviations from the cumulative season pattern.

Refining

The refining industry is made up of plants that conduct one or more processing operations used to refine and further prepare crude fats and oils. The refining is carried out by one of three methods: alkali, steam, or miscella. Alkali refining is the most widely used process.

The steam method is used for refining lard and edible tallow, and the miscella method is used for cottonseed oil. Refining removes undesirable constituents of crude oil such as free fatty acids, color bodies or pigments, water, and nonfatty material such as gums. After refining, the oil may be further processed depending on the end use for which it is intended. Refining of crude soybean oil is usually carried out by combining it with an alkali, usually caustic soda (lye). The refined soybean oil is drawn off and the remaining material is called soybean soapstock or foots which may be used to make soap, fatty acids, and glycerine or may be added to livestock feeds to increase the energy content and to impart other desirable characteristics to mixed feeds.

The Economic Research Service conducted a survey to determine the U.S. edible fats and oil refining ca-

pacities in 1982/83 (*71*). Industry responses came from 58 plants operated by 29 companies. These plants refined 88 percent of the reported total edible vegetable oils production in 1982/83. The survey highlighted the fact that the refining industry has become more concentrated since a similar survey was taken in 1975 when 97 refineries operated by 49 companies, representing 100 percent of the industry, responded (*32*). Concentration increased among the alkali refineries, which accounted for over 95 percent of the total refining capacity, with the 14 largest plants accounting for nearly 60 percent of the reported capacity compared with 41 percent in 1975.

Total refining capacity was 16.9 billion pounds in 1982/83, up 17 percent from the refining capacity reported in the 1975 survey. Plants operated at 76 percent of capacity in 1982/83, up somewhat from 71 percent in 1975. Respondents reported no current or planned capacity expansion of their plants. Soybean oil accounted for nearly 75 percent of the total refined output of fats and oils. Corn oil ranked second at 7 percent of all fats and oils, slightly above cottonseed oil in the survey.

Plants engaged in refining operations vary widely in size with a large proportion performing additional steps in fats and oils processing. A profile of the 47 alkali refineries in the 1983 survey showed the 14 largest plants (350–1,100 million pounds) held nearly 60 percent of the alkali-refining capacity. The 14 largest alkali refineries in 1975 ranged in size from 350–750 million pounds of maximum capacity and held 41 percent of the total alkali-refining capacity. Eight plants had alkali-refining capacity between 250–350 million pounds in 1982/83. These plants accounted for 16.5 percent of the total, barely half that reported in 1975. The largest proportion of the alkali refineries had capacities of 125–250 million pounds. Yet, these 16 plants held only 22 percent of the reported capacity. The nine smallest plants ranged in size from 10–125 million pounds and claimed less than 4 percent of the reported alkali-refining capacity.

Edible fats and oils refineries are located in large metropolitan consuming centers and in oilseed production areas. In the past, refineries were primarily located in the large cities where they received crude soybean oil, refined it, and manufactured edible fat products which were marketed in nearby markets. The trend in recent years has been for companies with large soybean oil mills, located in the soybean producing areas, to construct refineries adjacent to these oil mills. This arrangement provides more flexibility in marketing their soybean oil. They are no longer restricted to selling only crude oil to refiners but can sell refined oil to the many manufacturers of edible fat products. Most refiners also produce finished products such as salad and cooking oils, shortening, and margarine, and package them in a wide variety of containers.

The 58 processors of edible fats and oils responding for the survey were located in 21 States. Over half of the refiners were concentrated in four States: Illinois, 10 plants; California, 9 plants; Texas, 8 plants; and Tennessee, 4 plants. With the addition of three plants each in New Jersey, Georgia, Ohio, and Iowa, 75 percent of the plants were in only eight States. Forty-three percent of the reported refined output of fats and oils came from 16 plants in the regional grouping of Minnesota, Wisconsin, Michigan, Illinois, Indiana, and Ohio.

Storage and Handling

The orderly movement of soybeans to oil extraction plants and overseas port terminals from farms usually involves storage at several locations along the way. Soybeans may be stored on the farm where they were produced or off the farm in commercial storage facilities (table 34). Soybeans enter the marketing system on delivery to country elevators and other marketing firms for storage (*21*). Soybeans are then moved to terminal markets for further storage or delivery to more distant terminals. From these terminals, the soybeans go into export trade or to extraction plants where they are stored until crushed. Sometimes one or more of these intermediate stages may be bypassed.

Farm Storage

The percentage of soybeans stored on the farm has increased since the 1960's (table 34). Some portion of this increase is due to Government-sponsored storage construction programs, but the increase also reflects the desire of soybean farmers to take advantage of the marketing flexibility that storage offers.

Onfarm drying and storage generally requires facilities with enough capacity for 1 year's production. Other requirements include access to roads and electric power and a layout to facilitate loading and unloading of bins.

Farmers must decide on the best time to market their soybeans for maximum returns. Soybeans may be sold prior to harvest on a cash contract, at harvesttime, or they may be stored and sold at a later date (see "Marketing Strategies" on page 24). Because most soybeans are crushed at off-farm commercial facilities, onfarm storage is primarily for speculative purposes. When deciding whether or not to store soy-

Table 34—U.S. soybean stocks: Onfarm, off-farm, and total all positions

Date	Onfarm	Off-farm	Total	Date	Onfarm	Off-farm	Total
	1,000 bushels				*1,000 bushels*		
1965:				1976:			
Jan. 1	1,096,000	334,820	525,548	Jan. 1	590,926	665,689	1,256,615
Apr. 1	98,002	249,035	347,037	Apr. 1	411,535	456,283	867,818
July 1	22,982	108,465	131,447	June 1[1]	254,029	300,938	554,967
Sept. 1	7,568	22,132	29,700	Sept. 1	86,159	158,781	244,940
1966:				1977:			
Jan. 1	284,312	334,554	618,866	Jan. 1	473,405	559,045	1,032,450
Apr. 1	149,747	225,888	37,563	Apr. 1	227,794	390,214	618,008
July 1	19,155	114,867	134,022	June 1	92,400	243,335	335,735
Sept. 1	4,412	31,227	35,639	Sept. 1	32,756	70,168	102,924
1967:				1978:			
Jan. 1	344,394	377,041	721,435	Jan. 1	674,550	652,400	1,326,950
Apr. 1	217,411	240,500	457,911	Apr. 1	394,405	455,448	849,853
July 1	84,611	114,170	198,781	June 1	207,541	298,815	506,356
Sept. 1	41,626	48,511	90,137	Sept. 1	59,132	102,044	161,176
1968:				1979:			
Jan. 1	350,816	432,333	783,149	Jan. 1	699,556	692,534	1,392,090
Apr. 1	235,842	301,182	537,024	Apr. 1	412,570	467,646	880,216
July 1	120,620	164,389	284,991	June 1	241,255	284,850	526,105
Sept. 1	60,709	105,618	166,327	Sept. 1	61,509	112,579	174,088
1969:				1980:			
Jan. 1	410,168	550,329	960,497	Jan. 1	892,934	877,896	1,770,830
Apr. 1	276,930	452,343	729,273	Apr. 1	602,779	580,322	1,183,101
July 1	141,360	316,815	458,175	June 1	396,650	378,152	774,802
Sept. 1	71,852	254,992	326,844	Sept. 1	128,888	229,880	358,768
1970:				1981:			
Jan. 1	372,069	683,425	1,055,494	Jan. 1	730,157	790,300	1,520,437
Apr. 1	209,236	525,001	734,237	Apr. 1	533,082	469,619	1,029,701
July 1	78,711	324,676	403,387	June 1	362,266	317,156	679,422
Sept. 1	40,580	189,256	229,836	Sept. 1	159,029	159,276	318,305
1971:				1982:			
Jan. 1	391,960	553,012	944,972	Jan. 1	901,145	743,188	1,644,333
Apr. 1	246,491	369,063	615,554	Apr. 1	591,073	459,361	1,050,414
July 1	90,595	190,832	281,427	June 1	366,549	291,921	658,470
Sept.1	20,554	78,225	98,779	Sept. 1	131,921	136,571	268,492
1972:				1983:			
Jan. 1	397,631	491,387	889,018	Jan. 1	1,008,139	757,560	1,762,699
Apr. 1	218,618	333,677	552,295	Apr. 1	643,143	504,529	1,147,663
July 1	58,440	174,832	232,834	June 1	424,658	365,966	790,624
Sept. 1	11,779	60,183	71,962	Sept. 1	118,574	226,060	344,634
1973:				1984:			
Jan. 1	428,798	437,924	866,722	Jan. 1	620,171	670,384	1,290,555
Apr. 1	145,261	358,372	503,633	Apr. 1	374,237	415,765	790,002
July 1	33,847	145,352	179,199	June 1	179,601	292,085	471,686
Sept.1	9,412	50,222	59,634	Sept. 1	67,912	107,784	175,696
1974:				1985:			
Jan. 1	607,233	552,756	1,159,989	Jan. 1	766,335	655,724	1,422,059
Apr. 1	331,221	405,943	737,154	Apr. 1	487,369	408,632	896,001
July 1	150,738	190,865	341,603	June 1	326,596	281,821	608,417
Sept. 1	64,414	106,337	170,751	Sept. 1	143,221	172,836	316,057
1975:				1986:			
Jan. 1	484,978	505,392	990,370	Mar. 1[2]	699,339	671,929	1,371,300
Apr. 1	411,535	323,317	655,413	June 1	411,740	437,186	848,926
July 1	165,597	191,704	357,301	Sept. 1	167,090	369,275	536,365
Sept. 1	78,229	109,922	188,151	Dec. 1	1,086,000	895,437	1,981,437

[1] Reporting date changed from July 1 to June 1 in 1976.
[2] Reporting dates changed to March 1, June 1, September 1, and December 1.
Source: (*50, 59*).

beans, a farmer must consider several factors: (1) availability of storage space, (2) cost involved in storing, (3) possible losses due to damage caused by insects, rodents, shrinkage, and spoilage, and (4) possible changes in price. Prices generally rise during the storage period because a temporary glut usually occurs at harvesttime; but the main question is whether prices will increase enough to cover all of the storage costs. The average onfarm storage period is 4–5 months (*25*).

Onfarm soybean storage does not necessarily guarantee extra profits. However, seasonal price movements are often large enough for growers to realize extra income by storing their soybeans. The 1984/85 season was an exception, however. Soybean prices not only failed to increase, but steadily dropped from $6.01 per bushel in November to $5.70 per bushel in May.

Farmers with onfarm soybean drying and storage facilities have certain advantages over other soybean producers because they can harvest their soybeans earlier when moisture content is high and thus reduce yield losses. These producers also have greater flexibility in scheduling harvest when storage space is readily available. They can also dispose of their soybean crop at any time suitable to them, and they can participate in the soybean loan program without having to secure storage space in commercial elevators.

The Government encourages storage of soybeans through its nonrecourse loan program and through its farm facility loan program. However, onfarm drying and storage may not be profitable for all soybean production situations, especially for small farm operations.

Commercial Storage

Soybeans compete with wheat, corn, and other feed grains for bin space (*45*). The total off-farm storage capacity for grains was estimated at about 8.29 billion bushels (*58*). Commercial storage rates are generally higher than onfarm storage costs.

All commercial storage facilities, whether located at the country elevator, terminal elevator, or processing plant, are equipped with facilities to protect and maintain the quality of soybeans. Normally, elevators have their own cleaning equipment. The usual practice is to clean soybeans on arrival at the elevator in order to remove high-moisture weed seeds and trash, reducing the risk of mold growth and heat deterioration.

Moisture is a major factor in the safe storage of soybeans. In general, the higher the moisture and temperature, the shorter the permissible storage period. These two conditions influence mold development and the resultant spoilage of soybeans in storage (*2, 7, 28*). Soybean drying is accomplished by forcing warm air through the soybeans in the storage bin to remove excess moisture. To safely store soybeans for long periods of time, the moisture content of the beans should be reduced to 12 percent or even 11 percent (*2, 43, 49*). Mold growth is greatly reduced when moisture falls to these levels or below. There are also disadvantages when moisture content of soybeans is too low. Storage handling of beans containing 8- to 9-percent moisture frequently results in splitting, mechanically damaging the beans to the extent that they are lowered one or more market grades (*49*). The temperature of soybeans is lowered by aeration. The aeration is accomplished by using a fan to force air through bins of beans. Cooling the beans helps retard the growth of mold and reduces insect activity (*72*).

Shrinkage occurs during the storage period due to loss of moisture and the actual loss from rodents, insects, and handling operations. One-quarter of 1 percent appears to be a reasonable shrinkage allowance for each handling operation in storing soybeans on farms, or 0.5 percent for in-and-out handling (*49*).

Country Elevators. Farmers normally sell about 80 percent of their soybean crop to country elevators either at harvesttime or after a period of farm or commercial storage. Soybean producers sell about 3 percent of total production directly to soybean processors. Country elevators sell their soybeans to dealers in terminal markets, domestic processors, and exporters. Those soybeans purchased by terminal market firms are then sold to domestic processors or to exporters.

Storage at Feed and Oil Mills. Storage of soybeans at feed and oil mills is usually in facilities similar to those found at country or terminal elevators. These storage facilities usually consist of several large round silos. Facilities are available for unloading both trucks and railroad cars (many mills can also unload barges) and for cleaning and drying soybeans received at the processing plant. Soybean processing plants usually have facilities to store enough soybeans for 80–100 days of operation (*3*).

Because soybean oil and soybean meal stocks are more perishable than soybean stocks, inventory holders prefer to hold soybeans for speculative purposes. Oil and meal inventories remain relatively constant throughout the crop year, reflecting the amount of crush and pipeline demands for the products (tables 35 and 36).

Market Flow Patterns and Transportation Modes

Marketing U.S. soybeans involves moving large quantities of soybeans from production areas to processing and export points. These movements require a large transport capacity involving different modes of transportation. This section provides information on the movement of soybeans from production areas to processing and export points.

Although the marketing of soybeans involves many interregional movements, nearly 80 percent of all U.S. soybean exports pass through ports on the Gulf of Mexico. The inland waterway system is a vital link to gulf ports.

Table 35—U.S. soybean oil factory and warehouse stocks, total crude and refined, end of month

Year	October	November	December	January	February	March	April	May	June	July	August	September
	1,000 pounds											
1970	527,277	717,631	755,691	751,778	787,824	755,971	765,751	757,951	719,026	745,336	819,209	772,564
1971	725,883	808,669	802,206	782,834	847,085	881,171	952,671	944,966	824,656	854,068	841,639	785,182
1972	806,191	839,113	896,503	948,588	966,480	920,539	1,004,830	900,096	822,696	748,718	620,052	515,535
1973	531,531	599,918	690,503	623,251	642,446	626,028	726,267	765,131	708,599	702,713	777,152	793,529
1974	734,687	681,511	673,611	689,587	633,747	647,358	662,215	606,683	530,617	544,303	567,109	560,557
1975	567,955	657,652	799,873	844,788	931,245	946,065	1,060,933	1,108,603	1,274,500	1,229,867	1,294,573	1,250,605
1976	1,350,561	1,431,985	1,488,132	1,599,495	1,609,404	1,486,351	1,478,879	1,354,996	1,168,358	1,031,993	937,294	771,100
1977	752,100	766,548	859,223	913,834	856,505	803,775	822,179	828,717	834,434	820,805	777,488	728,628
1978	813,426	837,091	970,555	932,217	942,820	1,004,182	987,290	1,042,967	922,910	914,790	815,068	775,758
1979	819,786	867,324	1,030,142	1,115,190	1,204,539	1,175,879	1,183,687	1,144,814	1,225,892	1,305,029	1,262,971	1,210,170
1980	1,373,856	1,677,251	1,737,787	1,900,067	1,976,281	2,016,674	2,118,480	2,166,299	2,138,559	2,024,412	1,783,122	1,736,118
1981	1,790,191	1,884,443	2,023,748	2,159,951	2,140,591	2,141,371	2,111,639	2,017,694	1,889,417	1,647,378	1,397,445	1,102,548
1982	1,207,784	1,304,666	1,568,625	1,713,377	1,700,332	1,841,770	1,600,436	1,551,879	1,545,932	1,411,385	1,407,568	1,260,946
1983	1,453,436	1,660,587	1,919,206	1,907,038	1,582,883	1,519,623	1,380,110	1,209,713	1,011,811	989,601	871,091	720,509
1984	597,196	580,123	777,058	883,572	723,898	715,583	665,952	706,746	731,959	724,199	715,742	640,071
1985	636,080	810,380	969,431	1,167,396	1,181,063	1,246,599	1,219,263	1,360,161	1,225,218	1,320,820	1,152,197	946,593

Source: (55).

Table 36—U.S. soybean cake and meal: Stocks, end of month

Year	October	November	December	January	February	March	April	May	June	July	August	September
	1,000 tons											
1965	131.2	133.4	95.6	123.4	131.0	151.6	138.5	181.5	174.5	218.7	149.1	131.6
1966	149.0	146.1	136.1	151.5	126.6	101.6	163.4	129.5	144.0	167.6	131.7	137.7
1967	178.7	186.1	214.3	155.8	171.8	214.7	172.5	148.9	185.4	177.5	148.7	145.1
1968	155.7	153.4	197.2	228.4	216.5	184.8	181.3	193.6	168.1	178.4	176.3	156.8
1969	159.1	173.2	131.6	135.8	154.3	149.8	156.9	233.5	213.1	164.3	207.0	137.0
1970	166.8	182.7	129.7	185.5	189.3	153.2	168.1	219.3	169.1	215.0	215.4	145.8
1971	205.2	192.8	144.3	153.9	135.5	160.5	218.0	186.7	189.1	243.2	221.6	191.7
1972	185.7	170.7	217.9	193.3	210.0	206.3	213.5	203.4	204.5	214.4	212.8	183.2
1973	234.3	242.2	284.6	249.0	281.1	361.6	348.0	427.9	514.3	475.9	535.4	507.3
1974	508.2	563.7	529.0	541.0	540.0	556.7	470.5	448.1	421.7	394.8	404.5	358.3
1975	396.1	441.4	371.4	378.1	419.5	358.3	358.8	462.8	369.8	406.9	350.5	354.9
1976	423.5	427.7	353.9	384.7	429.9	412.6	449.0	408.3	390.7	399.0	270.4	228.3
1977	270.0	304.3	244.6	251.7	239.7	227.3	298.5	263.3	191.1	262.6	234.1	242.9
1978	239.5	205.9	289.1	242.2	225.0	238.2	264.7	237.2	239.0	262.3	173.7	267.4
1979	234.3	195.2	240.5	184.3	191.3	251.1	226.1	299.0	302.1	267.8	262.1	225.6
1980	242.4	381.4	249.7	243.5	248.1	271.4	211.7	287.6	241.1	188.8	233.8	162.7
1981	309.2	314.8	279.4	315.7	324.9	190.3	172.1	309.3	224.9	209.1	189.7	175.2
1982	342.8	349.6	332.3	400.2	422.8	341.0	356.1	341.5	272.3	365.2	378.5	474.1
1983	419.3	466.8	391.1	475.8	446.7	460.7	418.6	427.2	391.2	355.5	242.7	255.4
1984	236.1	285.7	336.8	319.6	334.1	444.6	429.8	495.8	569.6	562.5	458.0	386.9
1985	318.4	369.2	358.4	372.4	281.3	386.6	300.8	282.4	278.7	250.6	298.3	211.7

Source: (55).

The soybean processing industry, which is the major domestic outlet for soybeans, has accounted for 55 percent of total soybean disappearance on average for the last 5 years. Soybean processing plants are located in 21 States.

The following discussion is based on data from 1977, the last year for which comprehensive soybean shipment figures are available (*34*). Specific values may have changed since then, but the overall market flow patterns probably remain valid.

Shipments by Region

Grain marketing firms in the United States reported shipping about 1.7 billion bushels of soybeans in 1977 (table 37). A portion of those shipments included the same soybeans transported by several firms at different points along the way. In Illinois, for example, about two-thirds of the soybeans handled by river elevators were shipped from country elevators. The remainder was moved directly from farms.

About 49 percent of the total volume was transported to destinations within the region in which the shipments originated. These movements were predominantly shipments from country elevators to river elevators, terminal elevators, and processors located in the same region. Soybean processing plants have traditionally been located in production areas; thus, most soybeans for crushing are purchased from nearby sources.

In the Southeast regions (Mid-South, South Atlantic, and Mid-Atlantic), several large processing plants process more soybeans than can be produced locally. At the same time, local export firms compete with processors for soybeans produced in many of these States. Thus, southeastern processors often purchase soybeans from sources in the Corn Belt, and southeastern marketing firms ship locally produced beans to export points. Interregional shipments of soybeans totaled 231 million bushels in 1977 (table 37). About three-fourths of these movements originated in the Corn Belt.

Grain marketing firms shipped about 630 million bushels of soybeans to U.S. ports in 1977 (table 37). Firms in Illinois were the most important source for soybeans moving to port. They shipped over 126 million bushels, 20 percent of the total, to port destinations. Ohio, Louisiana, Iowa, and Arkansas rank second through fifth, in terms of volume shipped to port locations with each State shipping more than 50 million bushels. In total, firms in the Corn Belt and Delta originated 80 percent of U.S. soybean exports in 1977.

The volume of soybean shipments to various export locations varies markedly from region to region (table 38). Ports located on the gulf coast were the destinations for 485 million bushels, 77 percent of the U.S.

Table 37—U.S. shipments of soybeans to domestic destinations and export regions, 1977

Originating region [1]	Domestic destination [2]		Export regions	Total
	Within region	Outside region		
	Million bushels			
Northeast	0	4	1	5
Mid-Atlantic	30	1	8	39
South Atlantic	17	2	7	26
Lake States	75	9	53	137
Corn Belt	493	164	345	1,002
Mid-South	77	15	43	135
Delta	100	14	156	270
Northern Plains	38	19	5	62
Southern Plains	1	3	12	16
Mountain	0	0	0	0
Pacific	0	0	0	0
Total	831	231	630	1,692

[1] States included in each region are Northeast (NJ, NY, and PA); Mid-Atlantic (DE, MD, NC, VA, and WV); South Atlantic (FL, GA, and SC); Lake States (MI, MN, and WI); Corn Belt (IL, IN, IA, MO, and OH); Mid-South (AL, KY, and TN); Delta States (AR, LA, and MS); Northern Plains (KS, NE, ND, and SD); and Southern Plains (OK and TX).

[2] Survey data from several States were aggregated to avoid disclosure of individual firm data. Consequently, movements between Alabama and Tennessee, between Kansas and Nebraska, among States in the Mid-Atlantic region, and among States in the South Atlantic region are shown as intrastate movements.

Source: (*33*).

Table 38—U.S. shipments of soybeans to export regions, 1977

Originating region	Great Lakes	Atlantic coast	Gulf coast	Pacific coast	Total
	1,000 bushels				
Northeast	0	1,263	0	0	1,263
Mid-Atlantic	0	7,546	0	0	7,546
South Atlantic	0	3,490	3,165	0	6,655
Lake States	18,594	4,055	29,922	539	53,110
Corn Belt	54,711	53,768	235,900	295	344,674
Mid-South	0	0	43,112	0	43,112
Delta	0	0	156,479	0	156,479
Northern Plains	0		4,685	469	5,154
Southern Plains	0	0	12,002	0	12,002
Mountain	0	0	0	0	0
Pacific	0	0	0	0	0
Total	73,305	70,122	485,265	1,303	629,995
			Percent		
Share of total	11.7	11.1	77.0	.2	100.0

Source: (*33*).

total. The balance of shipments were shared about equally by Great Lake and Atlantic ports. Most of the shipments moving to Great Lake ports originated in States adjacent to these port locations; thus, the shipments moved relatively short distances. Although some shipments to Atlantic ports originated at nearby points, the predominant origins for soybeans moving to Atlantic ports were Ohio and Indiana. Marketing firms in these two States originated about 70 percent of the soybeans shipped to Atlantic ports in 1977.

Firms in the Corn Belt shipped 236 million bushels to gulf ports in 1977, almost 50 percent of shipments to port elevators in the gulf coast region. The Delta, also an important source, shipped 156 million bushels, 32 percent of total soybean shipments, to gulf ports. Shipments to the Pacific region amounted to only 1.3 million bushels, mostly from Iowa, Kansas, Minnesota, and Nebraska.

Regional Destinations and Transportation Modes

In 1977, marketing firms and processors received 272 million bushels of soybeans from interregional origins (table 39). About 231 million bushels of soybeans from that total were shipped by marketing firms to interregional domestic destinations. Trucks hauled the balance directly from farmers located in adjacent States. The Corn Belt led all regions in terms of the volume received from interstate origins (table 39). About 50 percent of the Corn Belt total originated in Indiana, Iowa, and Missouri. Illinois, the leading soybean-producing State, led all States in the quantity of soybeans received from other States. Firms in northwestern Iowa received large shipments from Minnesota and South Dakota. Kansas and Nebraska processors received large quantities from Iowa and Missouri.

Processors and other marketing firms located in the Mid-South represent a sizable domestic market for Midwest soybeans. In 1977, the firms in that region received 53 million bushels from interstate origins. The Mid-South was the primary domestic destination for soybeans shipped by barge. In the Delta, Arkansas processors were the predominant destination.

Trucks were the main mode of transport for interregional domestic shipments of soybeans, accounting for 46 percent of the total volume shipped from elevators. The remainder was transported by rail, barge, and trucks originating on the farm (farm trucks) which accounted for 32, 7, and 15 percent of the total, respectively.

The quantity of soybeans received at Great Lakes ports in 1977 totaled 77 million bushels; 80 percent of the total was shipped by truck from nearby origins (table 40). Atlantic ports received 71 million bushels, 85 percent of which moved by rail. Most rail movements were unit trains originating in Ohio, Indiana, and eastern Illinois.

The gulf coast was the main destination of soybean shipments to export points. Barge transportation ac-

Table 39—U.S. soybean receipts in domestic regions from interregional origins, by transportation modes, 1977

Destination region	Quantity received	Modal share			
		Rail	Truck	Barge	Farm truck
	1,000 bushels	*Percent*			
Northeast	0	0	0	0	0
Mid-Atlantic	20,091	61.3	20.6	0	18.1
South Atlantic	15,408	94.5	5.5	0	0
Lake States	21,409	3.0	86.4	0	10.6
Corn Belt	103,883	17.3	63.3	0	19.4
Mid-South	53,473	44.7	24.7	26.9	3.7
Delta	31,287	28.0	35.1	13.1	23.8
Northern Plains	22,836	30.2	47.4	0	22.4
Southern Plains	3,139	60.5	35.9	0	3.6
West	0	0	0	0	0
U.S. total	271,526	32.0	46.2	6.8	15.0

Source: (*33*).

Table 40—Soybeans received at various port areas and shares transported by different modes, 1977

Export region and port area	Quantity received	Modal share			
		Rail	Truck	Barge	Farm truck
	1,000 bushels	*Percent*			
Great Lakes region	77,434	13	80	2	5
Chicago area	29,491	21	72	4	3
Toledo area	46,795	9	84	0	7
Saginaw area	1,148	0	100	0	0
Atlantic region	70,922	85	7	7	1
North Atlantic	14,140	92	10	0	0
South Atlantic	56,782	84	6	9	1
Gulf region	486,115	15	7	78	0
East gulf	71,122	45	7	47	1
Louisiana gulf	387,502	8	3	89	0
North Texas gulf	27,491	39	61	0	0
Pacific region	1,303	78	22	0	0
Columbia River	565	94	6	0	0
Puget Sound	443	43	57	0	0
California	295	100	0	0	0
Total received	635,774	23	15	61	1

Source: (*33*).

counted for 78 percent of the volume received at gulf ports, illustrating the importance of the inland waterway system in moving soybeans into export channels. The barge was the predominant mode of transport at all gulf port areas except the northern Texas gulf coast area where truck transportation accounted for about 60 percent of the soybeans received at that location.

Changes in Domestic Marketing Patterns

Market flow patterns change in response to changes in quantities produced and processed in various regions, the volume and location of exports, and the transportation rate structure.

The South has been a deficit feed grain area with a large grain-consuming poultry industry. The manufacturing of poultry feed in this region uses large volumes of soybean meal produced mostly at soybean crushing plants in the South. Soybean production in the South has expanded rapidly in recent years. The quantity produced exceeds processing requirements in several Southern States, but the location of a sizable proportion of the production in this region favors transporting soybeans to Atlantic and gulf ports rather than to local processors. Consequently, southern processors must fill some of their soybean requirements from sources outside the region.

In contrast, production in the eastern Corn Belt region greatly exceeds the requirements of local processors. Marketing firms in that region depend on markets outside the local area. An increasing share of these surpluses has been moving to export points in recent years. However, the South historically has been an important market for soybeans produced in the eastern Corn Belt because of the close proximity and existing transportation network.

The eastern Corn Belt has been an important source of supply for processing plants in the South, but the increased export activity has altered the trading pattern between these two regions. In 1970, for example, 68 million bushels were shipped to Southern States from eastern Corn Belt origins; by 1977 the volume had declined to about 62 million bushels. Although the total volume remained fairly stable, trading patterns shifted noticeably. In 1970, Illinois was the predominant supplier of soybeans for the southern market, accounting for almost 82 percent of the movements from eastern Corn Belt origins. The Illinois share dropped to 49 percent by 1977. The decline in shipments by Illinois firms was due largely to a sharp drop in the volume shipped to Mississippi processors. The rapid expansion in soybean exports from gulf ports was also an important factor. Transportation considerations give Illinois an advantage in shipping soybeans by barge to the gulf; however, shippers in Indiana and Ohio are competitive in the southeastern markets served by rail transportation. The volumes shipped from Indiana and Ohio to port regions also increased substantially between 1970 and 1977.

The Alabama-Tennessee area was the most important destination in the South. Shipments from the eastern Corn Belt totaled 27 million bushels in 1977; Illinois shipments accounted for almost 86 percent of the total. Kentucky, Georgia, and South Carolina remained important markets for eastern Corn Belt soybeans even though the volume shipped to those markets declined between 1970 and 1977. The South will probably continue to be an important market for soybeans produced in the Midwest because of the sizable movement of southern production into export markets.

World Production and Trade

Oilseed crops are the most valuable agricultural commodities produced in many regions of the world. Soybeans are a major share of oilseed production, nearly 50 percent of total world production in 1985.

Location of Production

The United States continues to be the leading producer of soybeans; however, the U.S. share of world production dropped from 74 percent in 1967–69 to 56 percent in 1984–86 (table 41). China's share also dropped substantially during that period. In contrast, Brazil and Argentina significantly increased their share of world production from about 3 percent in 1967–69 to more than 24 percent in 1984–86.

World Production Trends

World production of soybeans has grown markedly since the early 1970's (table 42). Production rose in

Table 41—Share of world soybean production by major producers for selected periods

Country	Share of world production	
	1967–69	1984–86
	Percent	
United States	74.4	56.0
Brazil	2.7	17.0
China	16.7	10.9
Argentina	.1	7.4
Paraguay	.1	.8
Other	6.0	7.9

Source: (59).

most soybean-producing regions, but the United States, Brazil, and Argentina have accounted for almost 85 percent of the increase in world production since 1970. Production in South America grew much more rapidly than in other major soybean-producing regions.

The growth in world production came from increased yields and increased area planted in soybeans. The area harvested worldwide rose about 90 percent from 1967/68 to 1985/86 (table 43). Soybean acreage grew most rapidly in South America. After increasing soybean acreage in the early 1970's, China, the third leading producer of soybeans, has reduced acreage to near the levels of the late 1960's.

Soybean yields have trended upward in all major soybean regions during the last 15 years or more (table 44). The increases, on average, were largest in Argentina and Brazil.

The soybean industry should continue growing, but at a much slower pace. Much of the growth in U.S. soybean use has come from foreign trade. The U.S. dominance of the world market has eroded recently because of competition from South American soybean production; increased foreign production of tree oils, especially palm oil; expanded European oilseed production, especially rapeseed; and unfavorable foreign trade policies. Foreign markets are vital to the future of the U.S. soybean industry.

World Trade

Soybeans and their products dominate U.S. exports of oilseeds and oilseed products, comprising 87 percent of oilseed export earnings and 20 percent of total U.S. agricultural export sales in the 1980's. The U.S. soybean industry has become increasingly dependent on the export market. About 42 percent of the U.S. soybean crop was exported as beans in the early 1980's, compared with 24 percent in the early 1960's and 37 percent in the early 1970's. The United States exported 25 percent of its soybean meal production and 15 percent of its soybean oil production in the 1980's.

Soybean trade. Three Western Hemisphere countries, the United States, Argentina, and Brazil, accounted for 95 percent of total soybean exports for the 1981/82–85/86 marketing years (table 45). The U.S. share of the soybean export market was 78 percent in 1980/81. This share rose to 86 percent in the next 2 marketing years, then fell for 3 years, ending at 77 percent in 1985/86. Trade data for 1985/86 show that U.S. soybean exports returned to 1983/84 levels. The rate of increase in soybean exports during the last decade was significantly larger in the South American countries than in other exporting countries, including the United States.

Japan is the leading importer of soybeans, accounting for 15–19 percent of the total world imports for

Table 42—Soybean production by country

Marketing year[1]	United States	Brazil	China	Argentina	Paraguay	Other	World total
	1,000 metric tons						
1967/68	26,575	654	6,950	22	14	2,239	36,454
1968/69	30,127	1,057	6,480	32	45	2,399	40,140
1969/70	30,839	1,509	6,200	27	52	2,410	41,037
1970/71	30,675	2,077	6,900	59	75	2,623	42,409
1971/72	32,009	3,666	7,900	78	97	2,667	46,417
1972/73	34,581	5,012	8,700	272	122	2,746	51,433
1973/74	42,118	7,876	10,000	496	181	3,283	63,954
1974/75	33,102	9,892	9,500	485	220	3,394	56,593
1975/76	42,139	11,227	10,000	695	284	3,954	68,299
1976/77	35,070	12,513	6,650	1,400	377	3,393	59,403
1977/78	48,097	9,541	7,250	2,700	333	4,204	72,125
1978/79	50,859	10,240	7,565	3,700	549	4,454	77,367
1979/80	61,525	15,156	7,460	3,600	575	5,192	93,705
1980/81	48,921	15,200	7,940	3,500	600	4,774	80,786
1981/82	54,135	12,835	9,325	4,150	600	4,947	86,292
1982/83	59,610	14,750	9,030	4,200	520	5,324	93,434
1983/84	44,518	15,541	9,760	7,000	550	5,710	83,080
1984/85	50,644	18,278	9,030	6,750	950	6,560	92,630
1985/86	57,113	14,100	10,500	7,300	600	7,260	96,880

[1] The marketing year begins in September for the United States and China, February for Brazil (April for 1976 and before), and April for Argentina and Paraguay.
Source: (59).

Table 43—Harvested area of soybeans by country

Marketing year[1]	United States	Brazil	China	Argentina	Paraguay	Other	World total
	1,000 hectares						
1967/68	16,109	722	8,180	20	14	2,826	27,871
1968/69	16,751	906	8,000	28	28	2,769	28,482
1969/70	16,729	1,319	8,000	26	40	2,956	29,070
1970/71	17,098	1,716	8,000	36	54	2,971	29,875
1971/72	17,282	2,840	8,300	68	76	3,055	31,621
1972/73	18,488	3,615	9,100	157	81	3,239	34,680
1973/74	22,528	5,143	9,100	344	127	3,545	40,787
1974/75	20,777	5,824	8,800	356	151	3,584	39,492
1975/76	21,698	6,417	9,100	434	173	3,362	41,184
1976/77	19,992	7,070	6,690	660	229	3,357	37,998
1977/78	23,403	7,782	6,850	1,250	272	3,657	43,214
1978/79	25,764	8,256	7,144	1,600	360	3,983	47,107
1979/80	28,467	8,774	7,247	2,030	400	4,314	51,232
1980/81	27,443	8,501	7,226	1,740	400	4,151	49,461
1981/82	26,776	8,202	8,024	1,986	400	4,543	49,931
1982/83	28,102	8,136	8,414	2,281	350	4,983	52,266
1983/84	25,303	9,421	7,567	2,910	420	4,794	50,415
1984/85	26,755	10,153	7,290	3,269	550	5,876	53,893
1985/86	24,922	9,450	7,720	3,350	550	6,010	52,000

[1] The marketing year begins in September for the United States and China, February for Brazil (April for 1976 and before), and April for Argentina and Paraguay.

Source: (*59*).

1980/81–85/86 (table 46). Half of the world soybean imports went to the European Community (EC) countries in 1985/86. This share is larger than the 40 percent which typically goes to the EC. Within the EC, the primary soybean importers are the Netherlands and the Federal Republic of Germany. These countries ship soybeans and soybean products to the rest of the EC.

Japan is the single biggest customer for U.S. soybeans. About 19 percent of U.S. exports during 1980/81–85/86 were sold to Japan. This figure is smaller than the 25 percent that went to Japan in the 1960's and 1970's. Between 50 and 60 percent of U.S. exports go to European nations. Spain, the Federal Republic of Germany, and the Netherlands are the United States' primary European markets. Mexico and Taiwan were minor markets in the 1960's, but each now accounts for 7 percent of U.S. exports.

Soybean meal trade. The United States and Brazil are the leading exporters of soybean meal, accounting for 56 percent of world soybean meal exports in 1984/86 (table 45). The U.S. and Brazilian share has declined from 74 percent they had in the late 1970's and early 1980's because of substantial growth in Argentine exports. Some EC countries import soybeans, crush them for oil and meal, and then ship much of the meal produced to other EC countries (table 47). This activity and direct imports of soybean meal make the EC both a major importer and a major exporter of soybean meal. EC and other European nations are the major importers of soybean meal and the primary destinations for U.S. soybean meal exports.

Table 44—Soybean yields in major producing countries

Periods	United States	Brazil	China	Argentina	Paraguay	Other	World
	Bushels per acre						
1967–71	26.6	17.8	12.6	18.2	19.8	12.6	20.9
1972–76	26.9	24.6	15.6	25.5	23.1	14.6	23.0
1977–81	29.8	24.1	16.3	30.3	21.5	16.6	25.4
1982–86	30.8	25.5	19.2	31.3	22.0	16.9	26.6

Source: (*59*).

Soybean oil trade. Brazil, the United States, and the EC are the leading exporters of soybean oil, accounting for 75 percent of world soybean oil exports (table 45). Argentina has expanded soybean oil exports from less than 2 percent to over 12 percent of the world total. Soybean oil imports are distributed more evenly among a larger number of countries than either soybeans or soybean meal (table 48). Major importers of soybean oil include the EC, India, Pakistan, Eastern European nations, and Mideast/North Africa countries. Pakistan is the leading recipient of U.S. soybean oil exports. Other important destinations for U.S. soybean oil are India, Mexico, and South American countries, except Brazil and Argentina.

Table 45—Exports of soybeans and soybean products

Product and country	Marketing years				
	1980/81	1981/82	1982/83	1983/84	1984/85
	1,000 metric tons				
Soybean exports:					
United States	19,712	25,285	24,634	20,215	16,279
Brazil	1,798	858	1,320	1,591	3,476
Argentina	2,700	1,876	1,417	2,970	3,292
Paraguay	630	830	610	430	845
Other	503	474	596	879	1,349
Total	25,343	29,323	28,577	26,085	25,241
Soybean meal exports:					
United States	6,154	6,266	6,449	4,862	4,460
Brazil	7,740	8,347	8,239	7,709	8,441
Argentina	408	736	1,547	2,117	2,875
EC–10[1]	3,811	4,261	5,302	4,586	4,537
Other	736	1,114	1,685	2,018	1,976
Total	18,849	20,724	23,222	21,292	22,889
Soybean oil exports:					
United States	740	942	918	827	753
Brazil	1,153	852	1,020	990	985
Argentina	64	120	274	427	510
EC–10[1]	865	948	946	981	937
Spain	411	478	420	538	265
Portugal	18	57	65	NA	106
Other	92	103	128	208	108
Total	3,343	3,500	3,771	3,971	3,664

NA = Not available.

Note: Individual marketing years, except for Argentina and Brazil which are converted to an October–September basis. For Northern Hemisphere countries, marketing years begin in the first year shown, and Southern Hemisphere countries begin in the second year.

[1] EC–10 = Belgium, Denmark, Federal Republic of Germany, France, Greece, Ireland, Italy, Luxembourg, Netherlands, and the United Kingdom.

Source: (*58*).

Table 46—Soybean imports

Country/region	Marketing year				
	1980/81	1981/82	1982/83	1983/84	1984/85
	1,000 metric tons				
European Community total	13,216	15,962	15,569	12,724	12,751
Germany, Fed. Rep.	3,080	3,680	3,525	2,353	2,874
Netherlands	2,938	3,105	2,960	2,800	2,831
Spain	2,790	3,196	3,040	2,600	1,939
Italy	1,131	1,460	1,584	1,087	1,374
Belgium–Luxembourg	1,098	1,510	1,601	1,530	1,312
Portugal	250	414	735	812	1,013
France	509	878	941	664	576
United Kingdom	1,022	1,288	672	500	485
Denmark	205	206	200	156	99
Eastern Europe	517	481	662	842	563
Soviet Union	1,476	1,485	992	950	850
Japan	4,213	4,486	4,871	4,728	4,611
Taiwan	1,075	1,170	1,272	1,360	1,467
South Korea	529	541	695	712	809
Mexico	1,370	566	1,070	1,442	1,430
Canada	401	424	410	280	229
Other	3,644	4,122	2,507	2,162	2,590
Total	26,441	29,237	28,048	25,200	25,320

Source: (*58*).

Table 47—Soybean meal imports

Country/region	Marketing year				
	1980/81	1981/82	1982/83	1983/84	1984/85
	1,000 metric tons				
European Community total	9,915	12,153	12,408	12,452	13,383
Mexico	150	41	180	50	78
Japan	290	103	177	181	94
Soviet Union	1,055	1,211	2,550	830	550
Eastern Europe	4,297	3,263	2,878	3,507	3,500
Other	3,552	4,171	4,572	4,780	5,185
Total	19,259	20,942	22,765	21,800	22,790

Source: (*58*).

Table 48–Soybean oil imports

Country/region	Marketing year				
	1980/81	1981/82	1982/83	1983/84	1984/85
	1,000 metric tons				
European Community	456	522	518	569	518
Mexico	25	80	26	67	49
Brazil	0	12	10	50	160
India	595	419	500	808	418
Pakistan	219	304	310	285	189
China	73	31	20	0	10
Soviet Union	112	192	230	100	325
Eastern Europe	202	127	218	181	199
Mideast/ North Africa	735	790	758	749	786
Other Latin America	457	472	503	464	455
Other	428	497	552	607	481
Total	3,302	3,446	3,645	3,880	3,590

Source: (*58*).

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Appendix A: Soybean Acreage, Yield, and Production Trends

Soybean planted acreage, yield, and production have increased over time. We used ordinary least squares regression to measure this upward trend. Results of this statistical procedure are shown in appendix table 1 and appendix figures 1–3. Significant positive trends were found in planted acres, yield, and production. The trend in planted acres was 1.68 million acres per year. The trend in production was 55.94 million bushels per year, and the trend in yield was 0.32 bushel per acre per year.

The upward trend in soybean acreage, yield, and production is also revealed in appendix table 2 which shows the means for different periods. The variability of planted acres, yield, and production in relation to these means is measured by the coefficients of variation shown in appendix table 3.

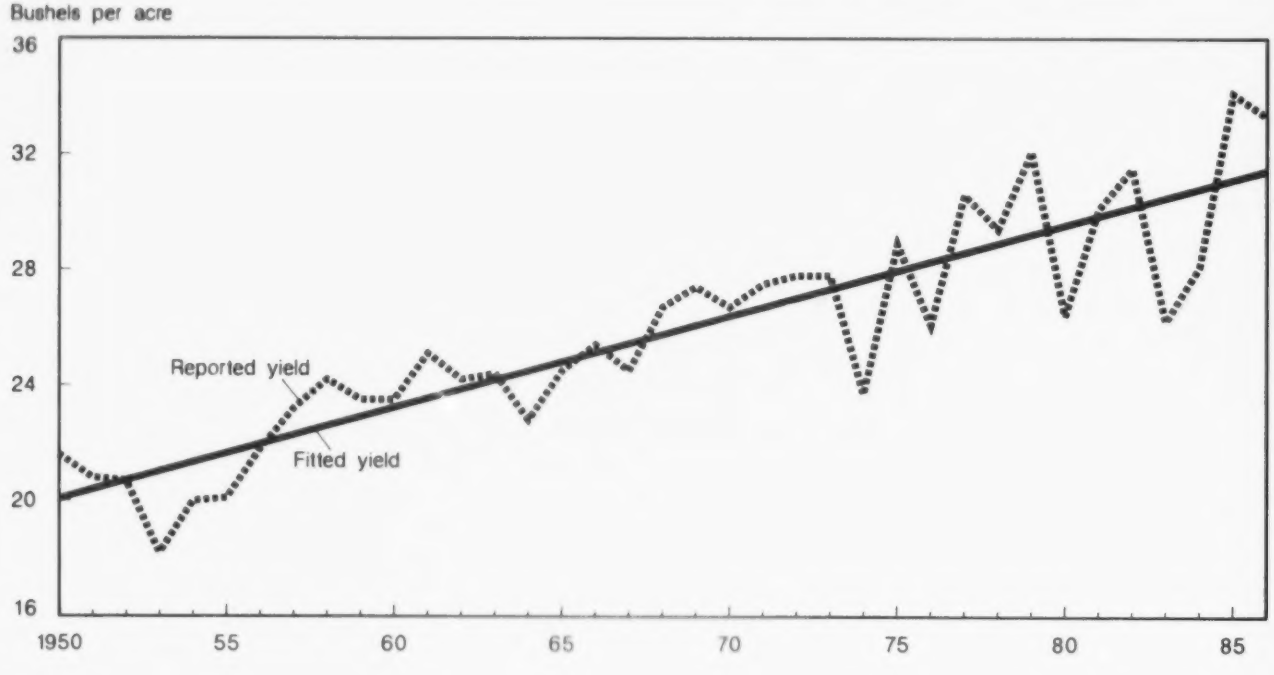
Appendix table 1—Trend regression results

Dependent variable	Trend coefficient [1]	Intercept	R-square
Million planted acres	1.68 (.06)	– 3,265	0.95
Million bushels produced	55.94 (2.65)	– 108,986	.93
Bushels per acre	.32 (.03)	– 595	.79

Note: Data are U.S. annual figures, 1950–86. The independent variable is the four-digit year.

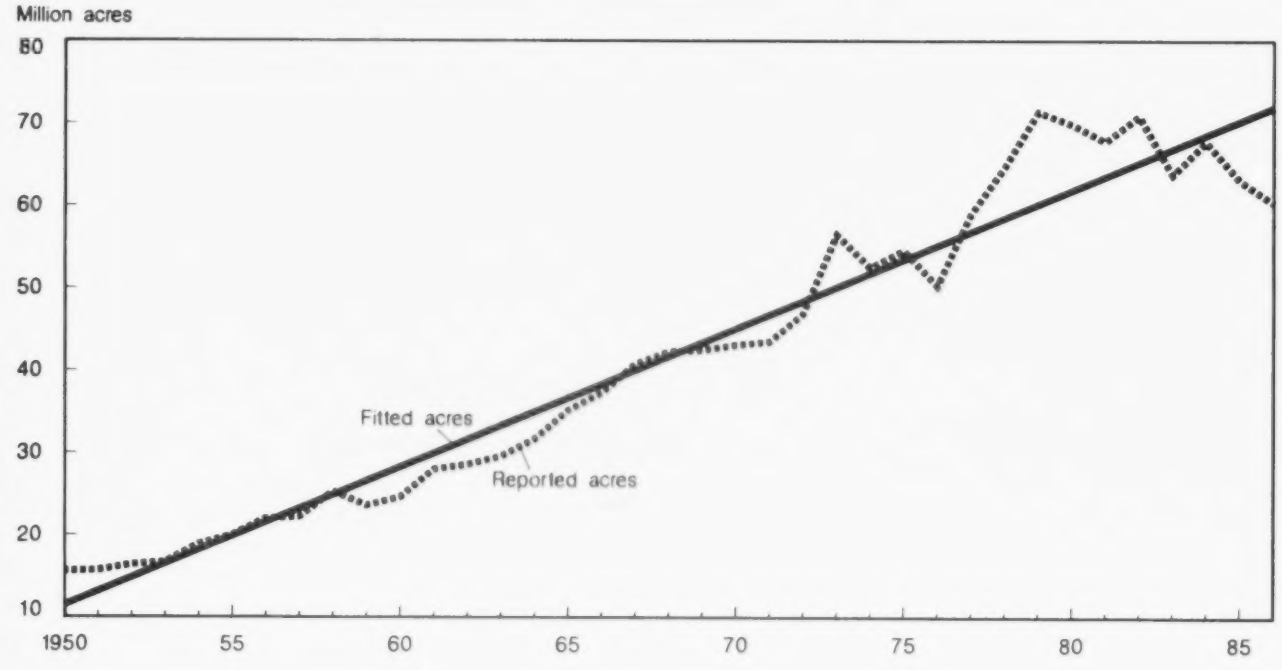
[1] Standard error of the coefficient is in parentheses.

Appendix figure 1
Soybean yield



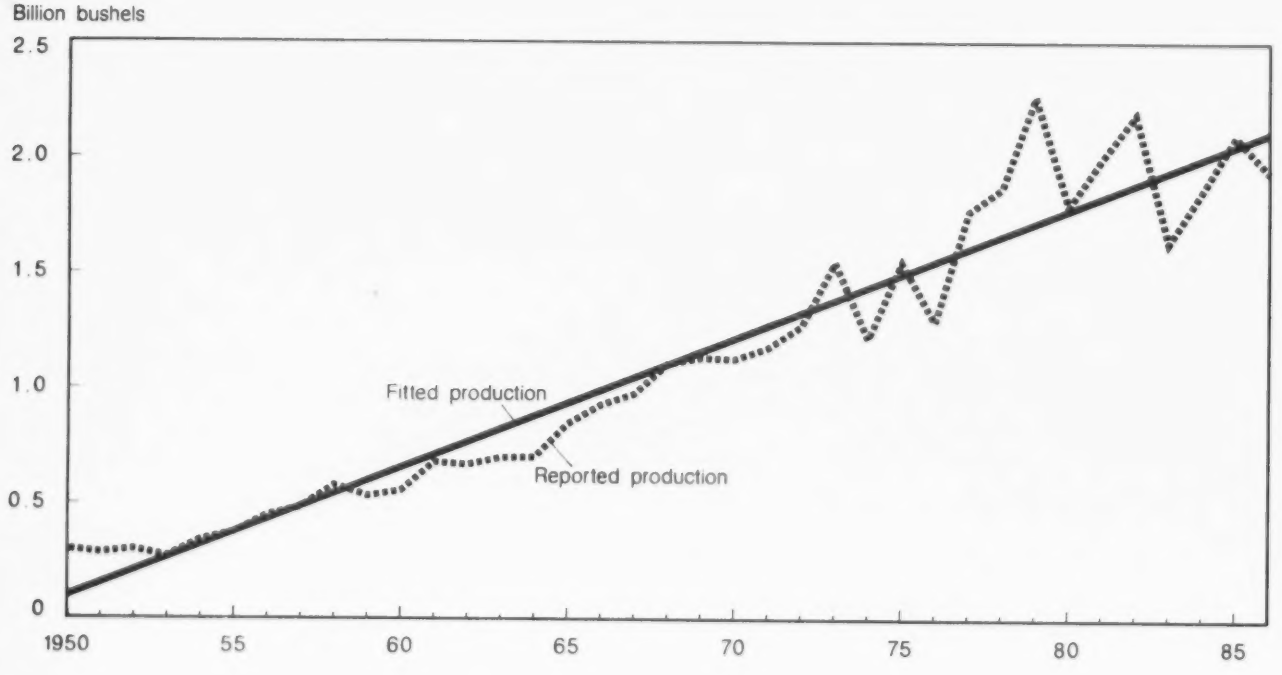
Appendix figure 2

Soybean planted acres



Appendix figure 3

Soybean production



Appendix table 2—Means for U.S. soybeans

Period	Means		
	Planted acres	Yield[1]	Production
	Million acres	*Bushels per acre*	*Million bushels*
1950–85	41.2	25.5	1,079
1950–59	19.6	21.4	391
1960–69	34.1	24.9	829
1970–79	54.3	28.1	1,508
1980–86	66.2	30.0	1,931
1950–54	16.7	20.3	298
1955–59	22.6	22.6	484
1960–64	28.5	24.0	661
1965–69	39.6	25.7	998
1970–74	48.5	26.7	1,268
1975–79	60.0	29.4	1,748
1980–84	68.0	28.5	1,896

[1] Unweighted arithmetic mean of annual data.

Appendix table 3—Coefficients of variation for U.S. soybeans

Period	Coefficient of variation		
	Planted acres	Yield	Production
1950–85	0.4470	0.1421	0.5660
1950–59	.1700	.0815	.2729
1960–69	.1805	.0528	.2282
1970–79	.1590	.0800	.2319
1980–86	.0541	.0900	.0985
1950–54	.0717	.0567	.0806
1955–59	.0780	.0646	.1462
1960–64	.0814	.0328	.0819
1965–69	.0730	.0456	.1085
1970–74	.1078	.0582	.1165
1975–79	.1239	.0678	.1873
1980–84	.0358	.0727	.0993

Appendix B: U.S. Standards for Soybeans

There are two classes of soybeans: Yellow soybeans and Mixed soybeans. There are no soybean subclasses. Yellow soybeans is the class most commonly exported by the U.S. market. Each class is divided into four U.S numerical grades and U.S. Sample grade. Special grades emphasize special qualities or conditions affecting the value of the soybean. These special grades are a part of the grade designation but do not affect the numerical or Sample grade designation. The at-par deliverable grade for futures contracts at the Chicago Board of Trade and the MidAmerica Commodity Exchange is No. 2 Yellow with substitution at differentials established by the exchanges.

Definitions for Standards

- *Test weight per bushel* is a determination of the number of pounds of soybeans in a Winchester bushel.
- *Moisture* is the water content of grain as determined by an approved electronic moisture meter. Effective September 9, 1985, the percentage of moisture in a sample does not affect the numerical grade.
- *Splits* are soybeans with more than one-fourth of the bean removed and which are not damaged.
- *Damaged kernels* are soybeans and pieces of soybeans which are badly ground damaged, badly weather damaged, diseased, frost damaged, heat damaged, insect bored, mold damaged, sprout damaged, stinkbug stung, or otherwise materially damaged.
- *Heat-damaged kernels* are soybeans and pieces of soybeans which are materially discolored and damaged by heat.
- *Foreign material* is all matter, including soybeans and pieces of soybeans, which will readily pass through an 8/64-inch sieve and all matter other than soybeans remaining on the sieve after sieving.
- *Soybeans of other colors* are soybeans which have green, black, brown, or bicolored seed coats. Before September 9, 1985, this factor was called "brown, black, and/or bicolored soybeans in yellow or green soybeans."

Appendix table 4—U.S. standards for soybeans

Grade	Minimum test weight per bushel	Maximum limits of —				
		Splits	Damaged kernels		Foreign material	Soybeans of other colors [1]
			Total	Heat damaged		
	Pounds	*Percent*				
U.S. No. 1	56	10	2	0.2	1	1
U.S. No. 2	54	20	3	.5	2	2
U.S. No. 3 [2]	52	30	5	1.0	3	5
U.S. No. 4 [3]	49	40	8	3.0	5	10

U.S. Sample grade:

U.S. Sample grade shall be soybeans which —

(a) Do not meet the requirements for U.S. Nos. 1, 2, 3, or 4; or

(b) Contain 8 or more stones which have an aggregate weight in excess of 0.2 percent of the sample weight, 2 or more pieces of broken glass, 3 or more crotalaria seeds (*Crotalaria* spp.), 2 or more castor beans (*Ricinus communis*), 4 or more pieces of an unknown substance(s) or a commonly recognized harmful or toxic substance(s), 10 or more pieces of rodent pellets, bird droppings, or an equivalent quantity of other animal filth per 1,000 grams of soybean; or

(c) Have a musty, sour, or commercially objectionable foreign odor (except garlic odor); or

(d) Are heating or otherwise of distinctly low quality.

[1] Soybeans which are purple mottled or stained shall be graded not higher than U.S. No. 3.

[2] Soybeans which are materially weathered shall be graded not higher than U.S. No. 4.

[3] As of September 9, 1985, moisture is no longer a grading factor for soybeans, although it is required to be shown on the certificate. Also, on the same date the factor "brown, black, and/or bicolored soybeans in yellow or green soybeans" was changed to "soybeans of other colors." In Mixed soybeans, the factor is disregarded.

Source: (*57*).

* U. S. GOVERNMENT PRINTING OFFICE : 1988-201-089 : 80174/ERS